The effect of blockchain technology on the South African banking environment

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DECLARATION

I, Jared Gray, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Jared Gray

Signed at ……

On the 15th day of February 2018

DEDICATION

First and foremost, I dedicate this Research Report to my mother and wish to express my appreciation and gratitude for her support throughout my academic career. Secondly, I would like to thank my brothers for setting a stellar example in all aspects of life and for motivating me in all pursuits of the same. In addition, I dedicate this research report to my girlfriend and thank her for patience, support and understanding throughout the MBA degree. Lastly, I want to thank God, through him all things are possible. It is only with his favour, that I could muster the courage and resilience to complete the MBA degree on a part-time basis.

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ABSTRACT

Blockchain technology is a foundational technology with various use cases that can significantly impact the manner in which banking is carried out in South Africa. The following paper seeks to put together a framework for understanding the potential effect of blockchain technology on the South African banking environment, with a specific focus on how blockchain technology will impact the South African banking environment (i.e. the applications and use cases) and when this impact will take place. A qualitative approach to addressing the problem statement was adopted, specifically in the form of focus interviews and strategic discussions with subject matter experts in both the blockchain and South African banking environment. Findings indicate that there are number of blockchain applications that can impact the South African banking environment namely, Private Digital Ledgers, Smart Contracts and Tokens/ Cryptocurrencies. Further to this, research indicates that the former is most likely in the short term, while the latter two applications are subject to a high-level stakeholder coordination, a high level of effort in educating the end customer and a high level of friction from existing systems and process, and will therefore only realise mass adoption in the long-term. As a result, this research contributes to providing an initial view of which applications are most likely to be adopted by South African banks and can form the foundation for further research in this area.

Keywords: Blockchain technology, Banking, South Africa

1. Introduction and background

The shift towards a digital world which is underpinned by changing technologies reinforces the case for businesses having a sound understanding of the technological landscape and how it can affect traditional methods of conducting business (Christensen, Raynor, & MC Donald, 2015). As result, business needs to understand its technological context, specifically the technologies that exist, how the technology will impact the business and the broader environment, and when this impact will take place (Christensen et al., 2015). In the case of the banking environment, blockchain protocol has emerged as a foundational technology that can potentially transform the fundamental manner in which banks operate and conduct business (Iansiti & Lakhani, 2017).

Blockchain technology was developed in 2008 (as the foundational technology for Cryptocurrencies- specifically Bitcoin), as means to solve the double spending problem and remove the need for third-party intermediaries that regulate and maintain administrative control over transactions within the banking system, through the use of a peer-to-peer framework, supported by decentralised digital ledger (Nakamoto, 2009). However, blockchain protocol has given birth to numerous applications such as cryptocurrencies, smart contracts and decentralised ledgers (to name a few), which can be adopted for use in the banking environment (Iansiti & Lakhani, 2017). Blockchain technology finds itself mimicking the internet[1], just as the internet decentralised the flow of information and the need for an intermediary to enable communication, so too will the financial services be impacted by the applications founded on blockchain technology, that can decentralise value and give society the ability to store and transfer value without the need of an intermediary or third party (Iansiti & Lakhani, 2017).

Blockchain technology has also given rise to the age of Fintech (Financial Technology) companies which can leverage the technology to offer more efficient services at a fraction of the cost and thereby disrupt the banking environment (Iansiti & Lakhani, 2017). Chain Core[2] and Stellar[3] are examples of the many Fintech (Financial technology) companies that have leveraged blockchain technology and its applications to offer banking and financial services that can disrupt traditional banks (Iansiti & Lakhani, 2017). Blockchain technology (and its applications) presents a case for further investigation by banking institutions, given the fact that it can reduce the level of exposure that banks have to risk and fraudulent activities, reduce the costs of banking and associated revenue streams incurred through elimination of administrative and clearing

1 The similarities between TCP/IP (Internet Protocol) and blockchain protocol are worth noting, given the fact that it is a foundational technology which led to the disruption of postal services (specifically mail delivery) by applications such as email, Skype etc. brought about by the advent of the internet (Iansiti & Lakhani, 2017).

2 Chain Core offers processing and transaction validation services for companies on the New York Stock Exchange utilising blockchain protocol (Chain Core, 2017).

3 Stellar which is an NPO Fintech seeks to connect the unbanked (in Africa) to low-cost financial services to fight poverty through the adoption of digital currencies based on blockchain technology (Stellar, 2017).

functions. Furthermore, blockchain technology can improve the efficiency of transactions which can be validated in real-time (Iansiti & Lakhani, 2017).

In the context of South Africa, significant interest has been given to blockchain technology with several large commercial banks having come together to investigate the idea of implementing large-scale blockchain protocol into their current systems (Del Castillo, 2017). Further to this, the SARB (South African Reserve Bank) has indicated that it is open to the idea of issuing a national digital currency based on a distributed digital ledger (much like Bitcoin), to leverage the benefits of blockchain technology (Naidoo, 2017). Currently, approximately 90% of ZAR (South African Rand) is stored as digital currency (i.e. digitally on a centralised ledger in banks), while the balance exists in notes and coin format (Ehsani, 2016).

As a result, blockchain technology does not only open the door to a new method of banking but to a whole new host of competitors and which will reshape the banking landscape. Therefore, the idea of the South African banking system underpinned by blockchain technology may very well be a reality in the not too distant future.

2. Problem/opportunity investigated

The notion of blockchain technology has become an increasingly popular topic in the world of finance and technology, paving the way for the development of over 700 Cryptocurrencies, enabling smart contracts and leading to the development of numerous Fintech companies (Ehsani, 2016). The technology has the potential to fundamentally transform the banking model, eliminating the need for trusted third parties or intermediaries to transact on behalf of individuals (Iansiti & Lakhani, 2017). As a result, a burning platform exists to better understand the impact of this technology and when this impact will be realised in the South African banking environment (Iansiti & Lakhani, 2017). While theory exists to understand the rate of adoption of new technologies as well as the impact of blockchain in the financial services and banking sector, limited focus has been placed on when this technology will be adopted by the banking environment and how it will look in the South African context.

As a result, the focus of this paper will to provide greater clarity and insight into understanding the impact of blockchain technology in the South African banking sector (in terms of the various applications that can be leveraged by banking institutions), as well as shed light on when will this impact be realised. Furthermore, the insight gained from this paper can provide an in-depth understanding of how blockchain technology can be leveraged by management and executives within banking institutions to better understand the role of the bank in the future and enable them to act accordingly with a stronger strategic context.

3. Objective/purpose of the research

The purpose of this research is to understand the effect that blockchain technology will have on the South African banking environment (in terms of the various applications that can be leveraged by banking institutions), with specific reference to how blockchain technology will impact the South African banking environment and understanding when the adoption of this technology will be realised in the sector.

4. Framework for understanding Blockchain Technology

4.1. What is Blockchain technology?

Developed in 2008 by Satoshi Nakomoto, blockchain technology seeks to address the gap between the digital world and the transactional environment (Iansiti & Lakhani, 2017). Blockchain technology is a digital structure that makes it possible to create a digital ledger of transactions and share it amongst a distributed network (Mager et al., 2016). Its strength lies in the fact that it leverages this digital distributed ledger which can allow for recording, processing, and storing of information while achieving consensus within a distributed network (Swan, 2016). As a result of its distributed ledger technology (DLT), blockchain removes the need for a third party or a trusted intermediary (Swan, 2016). To better understand the impact of blockchain technology on the South African banking environment, focus will be placed on reflecting which key areas of banking process will be affected and how. The focus of the paper will then shift to discussing Iansiti and Lakhani's Foundational Technology Adoption Theory (Iansiti & Lakhani, 2017).

4.2. Principles of Blockchain Technology

According to the work put forward by Iansiti and Lakhani, blockchain technology is underpinned by five key principles, specifically, a Distributed Database, Peer-to-Peer Transmission, Transparency with Pseudonymity, Permanent and Irreversible Records and lastly, Computational Logic (Iansiti & Lakhani, 2017).

The Distributed Database refers to the ledger or database been shared in a distributed fashion across a network of numerous participants (Iansiti & Lakhani, 2017). This ensures that each party on the network will have access to the ledger and its entire history. Furthermore, no single party controls the data and every party on the network can verify the transactions (Iansiti & Lakhani, 2017).

In terms of blockchain's Peer-to-Peer Transmission principle, communication occurs directly between the various participants instead of through a central node, which eliminates the need for a trusted or third-party intermediary (Iansiti & Lakhani, 2017). Each node will then store and forward information to various other nodes in the network (Iansiti & Lakhani, 2017).

Every transaction and its associated value on the network is visible to all participants however, each user or node on the network has a unique alphanumeric address that can be used as a unique identifier (Iansiti & Lakhani, 2017). Transactions occur between users on the network allowing for a level of Pseudonymity on the network, with complete transparency (Iansiti & Lakhani, 2017).

The fourth principle of blockchain technology is supported by the fact that once transactions are entered into the ledger, they are permanent, cannot be altered and are recorded in a chronological method (Iansiti & Lakhani, 2017).

Lastly, the digital nature of the ledger ensures that all transactions on the network can be associated with a level of computational logic, whereby users can develop algorithms and rules that automatically trigger transactions between nodes (Iansiti & Lakhani, 2017). Tied closely to the principle of computational logic is the notion of Proof-of-Work[4] and Proof-of-Stake[5] (Iansiti & Lakhani, 2017).

4.3. Applications of Blockchain Technology

Similar to how the internet[6] paved the way for various applications that have transformed the way business is conducted (e.g. email being used as the foundational technology which gave rise to Skype), so too has blockchain technology developed a platform for development of Decentralised Applications[7] (DAPPs) to fundamentally enhance the manner in which business-as-usual within banking environment is carried out (Iansiti & Lakhani, 2017). The DAPPs can be categorised into three broad categories specifically, Cryptocurrencies/Tokens, Sovereign and Public Digital Ledgers, and lastly Smart Contracts (Ehsani, 2016).

The first and best-known application of blockchain technology is Cryptocurrency (Ehsani, 2016). Cryptocurrency is a digital currency that leverages encryption to validate the transfer of funds and operate independently of a central bank or central authority (Iansiti & Lakhani, 2017). Much like fiat currencies, Cryptocurrency is underpinned by the notion of trust between organisations and individuals, and serves as a medium of exchange in the banking and financial world (Sullivan, 2015). There are over 700 Cryptocurrencies that exist, of which Bitcoin, Ethereum and Ripple are the most prevalent digital currencies with a market capitalisation of USD$14bn, USD$600m and USD$200m respectively (Rees, 2016).

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4 Proof-of-Work model, the mining operation has to spend the cost and energy of computing and solving the parameters of the block for the reward (Swan, 2016). The inherent costs involved in mining are the barrier to any individual or organisation that would seek to influence the network by controlling the majority of its mining ability (Swan, 2016).

5 Proof-of-Stake model requires miners to own a stake in the mining operation, but not necessarily be a host or a transaction party on the network (Swan, 2016), therefore the Proof-of-Stake model does not lend itself to disbursing block rewards, just transaction fees (Swan, 2016).

6 TCP/IP, which is otherwise known Internet Protocol (Iansiti & Lakhani, 2017).

7 Computer program with an interface enabling users to use blockchain technology as a tool to accomplish a specific task (Ehsani, 2016).

The second category of applications that blockchain technology has given rise to is Digital Ledgers[8] (Ehsani, 2016). Two types of Digital Ledgers exist, the first being Public Digital Ledgers and the latter is Sovereign/Private Digital Ledgers (Ehsani, 2016). A Public Digital Ledger is database that is a digital store of value on a public network that can be accessed by anyone, in contrast a Sovereign/Private Ledger is database that is a digital store of value on a private network that can only be accessed by parties that have permissions or rights to the network (Ehsani, 2016).

Lastly, Smart contracts (also known as self-executing contracts), use computational protocol to verify and enforce the performance of smart contracts, as well as autocorrect and update a contract without the need for contractual clauses (Iansiti & Lakhani, 2017). An example of early works in this space can be highlighted by the fact that Visa has demonstrated a proof-of-concept (for smart contracting) using blockchain technology to record contracts such as car leasing and insurance (Schneider et al., 2016).

5. How will Blockchain Technology impact the South African banking industry?

5.1. South African Banking Reimagined: Sovereign Ledgers, the digital building blocks between banks

According to Ehsani, the notion of a Sovereign or Private Ledgers maintained by a central authority (i.e. South African Reserve Bank) and various commercial banks is the first application of blockchain technology that can fundamentally change the how banks transact with each other and their customers (Ehsani, 2016). While there are various other platforms that can transform the manner in which banking is carried out, such as a Central Bank Issued Cryptocurrency (CBICC)[9] or a Smart Contracts that can remove the need for extensive due diligence and administrative controls when granting loans, Ehsani believes that Sovereign Ledgers will be the first blockchain technology application to be introduced into South Africa's banking environment (Ehsani, 2016). A similar view is evident in the work put forward by Iansiti and Lakhani, which suggests that the use of Private Ledger development is evident in the financial services sector, with private Fintech firms offering solutions to financial services institutions (Iansiti & Lakhani, 2017).

Sovereign Ledgers can be used between banks in similar regions under the jurisdiction of a central bank (Ehsani, 2016). The nodes or miners[10] on a sovereign blockchain will be the banks on this private blockchain and can therefore be known and trusted relative public blockchain which lends itself to a high level of anonymity (Ehsani, 2016). As a result, the introduction of a trusted or known participant into a blockchain by

8 Ethereum is currently the most prevalent decentralised platform that runs smart contracts, cryptocurrencies and various other applications (Ehsani, 2016).

9 CBICC is a Cryptocurrency or digital currency that will be introduced into the South Africa banking and financial system which will eventually replace the traditional fiat currency- Rand (ZAR) (Ehsani, 2016).

10 Mining is the chief property of blockchain computing, a process of independent administrators (miners) or nodes along the blockchain which validate and record transactions (Swan, 2016).

making it permissioned (i.e. security key is required to gain access to the blockchain), will reduce the burden of proof required in a public environment and thereby reduce costs, and improve transaction speed (Ehsani, 2016). An example of a sovereign digital ledger could be a digital distributed ledger established for use between the South African Reserve Bank and the major banks in South Africa to facilitate inter-bank transactions and central-to-commercial banks transactions.

Further to this, the ledger would capture the transactions of all financial instruments between the various participants, while the central authorities would be the moderators of the permissioned networks and would facilitate the selection of miners or participants as nodes (Ehsani, 2016). The participants within the sovereign blockchain would perform functions related to the submission of transactions (on behalf customers), validation and storage of all transactions on the network, as well as maintain the network (Ehsani, 2016).

The uptake of Sovereign Ledgers in the banking and finance sector evident with the likes of Fintech companies such as Chain Core and Ripple, offering technology for processing and validating financial transactions to Nasdaq (Chain Core, 2017), as well as the likes of the Bank of America, JP Morgan, the New York Stock Exchange and Standard Chartered all testing the blockchain technology as a replacement for paper-based and manual transaction processing in forging exchange, settlements and securities (Iansiti & Lakhani, 2017). In the context of South Africa, the notion of a Sovereign Ledger between banks is a strong reality with the first asset transferred on a Sovereign Ledger between several banks in late October 2016 (Naidoo, 2016). Among the commercial banks that were involved in this process were ABSA, Investec, Nedbank, Rand Merchant Bank and Standard Bank, while other stakeholders included the South African Reserve Bank (SARB), the Financial Services Board and the Payments Association of South Africa (Naidoo, 2016). Further to this, the SARB has expressed interest in blockchain technology and the notion of exploring blockchain technology and distributed ledgers (Naidoo, 2017). Currently, reporting to the SARB is done manually by most banks, a distributed ledger would remove the need for manual reporting thus reducing costs for the banks whilst increasing transparency and turnaround times (Ehsani, 2016).

5.2. Impact of Blockchain Technology on Banking Functions

Blockchain technology will have a significant impact on the banking sector specifically in the form of cost reduction, risk reduction and efficiency improvements (Ehsani, 2016). In the same breath, blockchain protocol could significantly impact bank revenue streams (administrative and handling charges etc.), therefore banks cannot be complacent regarding the impact of blockchain technology on their functions and processes, and therefore need to consider their core business functions accordingly (Ehsani, 2016). A

bank's core business can be categorised into the four distinct services[11] specifically, Value Storage, Value Transfer, Value Provision and Value Protection (Ehsani, 2016).

Value Storage is broadly categorised as the storage of all deposits and custodian services by banks (Ehsani, 2016). Currently, approximately 90% of ZAR is stored as digital currency (i.e. digitally on a centralised ledger in banks), while the balance exists in notes and coin format (Ehsani, 2016). As a result, the use of blockchain technology could dramatically reduce the credit risk profile of all commercial banks, through individuals or organisations controlling their own private keys or encryption keys to their value (money or assets) on the sovereign blockchain (Ehsani, 2016). As a result, the role of the bank can possibly morph from a custodian of funds to a custodian of private keys or encryption keys, with limited credit risk liability (i.e. no deposits) (Ehsani, 2016).

Value Transfer can be broadly categorised as the payments process and exchange of all assets and financial instruments (Ehsani, 2016). In short, payment systems rely on updating various ledgers between different institutions at the same time and reconciling those ledgers (Ehsani, 2016). Implementing a Sovereign Ledger solution between banks can reduce the cost of transactions and improve the efficiency and reliability of transactions, as they occur in real-time (Ehsani, 2016). On average, banks earn ~40% of their revenue through facilitating these payments (local and cross-border), as a result, migrating all digital money onto a Sovereign Ledger can reduce these revenue streams significantly, as the need to for the reconciliation of payments would diminish significantly (Ehsani, 2016). In summary, blockchain technology can potentially enhance the Value Transfer process and significantly reduce associated costs and revenues (Ehsani, 2016).

Lastly, Value Provision and Value Protection can be categorised as the provision of capital and insurance or derivative services provide by a bank (Ehsani, 2016). As the banking system migrates onto a sovereign blockchain, banking customers will have access to their own data and assets and can leverage funds from all capital providers in a more efficient and less costly manner (Ehsani, 2016). In the same breath, Smart Contracts established on sovereign ledgers can reduce risk through enabling margin calls for derivatives in short time periods as opposed to every 24 hours (Ehsani, 2016).

5.3. The Case for Blockchain Technology in the Banking Environment

As mentioned previously, blockchain technology makes it possible to create a digital ledger of transactions and share it amongst a distributed network (Mager et al., 2016). This defining feature can significantly improve the cost of transactions, reduce the risk and enhance the efficiency of transactions (Mager et al., 2016). In the case of banking and financial institutions, several benefits can be accessed through the use of

11 Advisory services are provided across the four core services by banking institutions but are not considered core (Ehsani, 2016)

blockchain technology specifically, fraud reduction, improved Know Your Customer (KYC) protocol, enhanced trading platforms and enhance payments (Mager et al., 2016).

Traditionally, bank ledgers are stored in a centralised manner and are protected by outdated legacy systems (Mager et al., 2016). This model has left the banking system exposed and more susceptible to fraud and cyber-attacks (Mager et al., 2016).This is evident in the case of the Russian Central Bank and various Russian commercial banks, that were subject to a series of cyber-attacks resulting in ~$31million dollars being stolen by hackers in early 2016 (Becker, 2016).Utilising blockchain technology, banking institutions can prevent fraud and theft by leveraging blockchain's distributed database and ledger, facilitating real-time transactions and execution of payments (Mager, Huls, & Taylor, 2016). Further to this, its transparency characteristics will allow for real-time fraud analysis (Mager et al., 2016).

Speaking to KYC controls, KYC requests underpin the banking process from a compliance and risk management perspective (Mager et al., 2016). The process entails identifying customers through a process of reviewing their constitutional documents[12], which can take up to 50 days, thereby delaying the banking process (Mager et al., 2016). Not only is the process lengthy, the cost of compliance and the financial penalties in place for not complying is onerous (Mager et al., 2016). As a result, blockchain technology can make the process simpler and cheaper due to the fact that the KYC statements can be captured and stored on the blockchain (Mager et al., 2016). South Africa's largest banks spend millions of Rands each year on KYC and the associated annual KYC reviews based on the risk profile of client (Mager et al., 2016).

The SARB has a zero-tolerance approach when the banks capture customer details incorrectly and often fine the banks large sums of money for not adhering to the FICA requirements (Mager et al., 2016).

Further to this, the FICA act is also undergoing constant change and banks are often on the back foot when it comes to implementing new requirements due to their legacy systems and processes in this space (Mager et al., 2016). A Blockchain solution would be quicker to adjust at a lower cost (Mager et al., 2016). As a result, blockchain technology will significantly reduce the time and cost of the process while improving customer experience as all banks will have access to the KYC documents on the Sovereign Ledger (Mager et al., 2016).

With regards to trading platforms, Blockchain Technology , can offers banks and other financial institutions a platform for trading or exchanging assets without the need of intermediaries, the risk of fraud, threat of double counting and reduce administrative costs (Mager et al., 2016). In the context of South African, specific reference to 17 banks (of which 3 were South African) that were charged with collusion by the South African Competition Commission for price fixing and market allocation in the trading of currency pairs in

12 Identification documents, proof of residence etc.

2017 (Wild, Bonorchis, & Morris, 2017). Using blockchain protocol as trading platform for forex (foreign exchange) would have proved useful, given blockchain's distributed ledger and transparency characteristics (Mager et al., 2016). As a result, collusion or fraudulent activity that sits on a distributed ledger between banks and governing would be able to be identified immediately and mitigated accordingly (Mager et al., 2016).

The last application or use of blockchain technology that can be leveraged by the banking environment is underpinned by cross boarder payments and remittances (Mager et al., 2016). Blockchain technology can be used as a medium to facilitate payments (cross-border) between people and organisations (Mager et al., 2016). While traditional payment systems are enabled by banks or central banks (Mager et al., 2016), Blockchain Technology seeks to evolve the current payment system through removing intermediaries between banks, organisations and individuals, thereby making the cost of transacting cheaper and enhancing the efficiency of the process (real-time/ instant payment) and lastly, enabling 24 hour transactions (Mager et al., 2016).

6. When will Blockchain Technology impact the South African banking industry?

6.1. Framework for Blockchain Adoption

Iansiti and Lakhani argue that blockchain is many years away from its full potential and wide acceptance (Iansiti & Lakhani, 2017). This is not only true for the banking and finance industry, but it also holds true for various other industries as well (Iansiti & Lakhani, 2017) However, with growing acceptance and increased use, it will eventually transform the way in which transactions and commerce are carried out in the banking environment (Iansiti & Lakhani, 2017). Given that blockchain is a foundational technology[13], Iansiti and Lakhani believe that the framework for the adoption of blockchain applications will mimic that of the internet (TCP/IP)[14] and can be measured according to two parameters, specifically, Degree of Complexity and Coordination, and Degree of Novelty, see Figure 1 below (Iansiti & Lakhani, 2017).

13 Supporting technology that can bring about the development of various applications

14 The internet (TCP/IP) is a foundational technology. Just like how it brought about the various applications such as email, Skype etc. so too will blockchain bring about various applications that will ultimately impact the banking system (Iansiti & Lakhani, 2017).

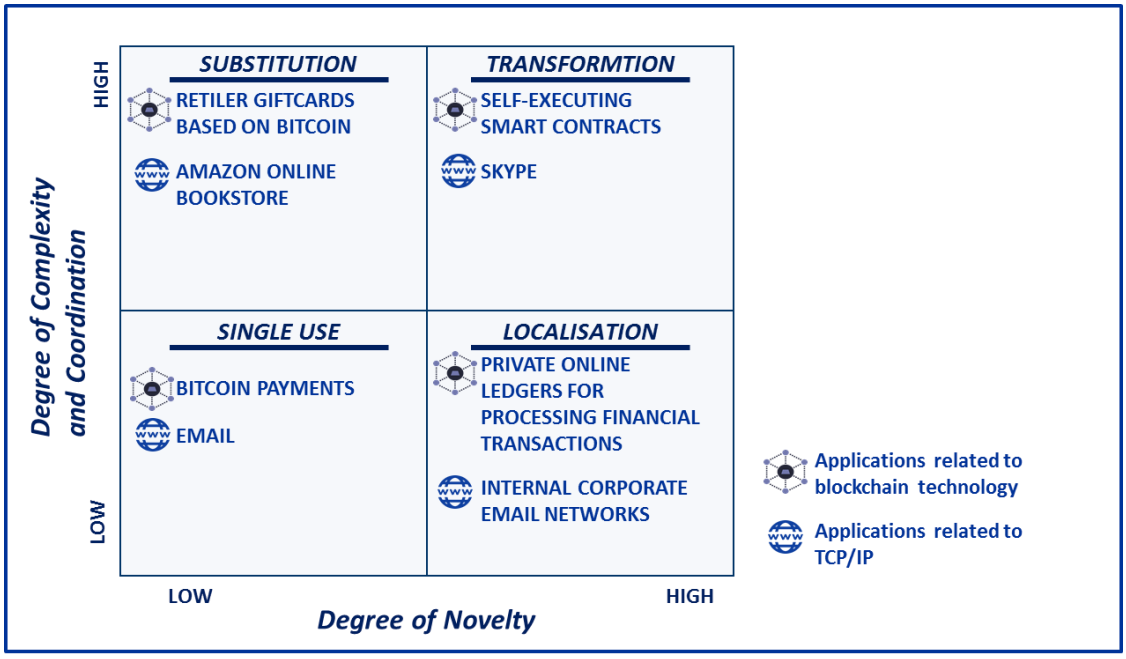

Figure 1: Framework for the adoption of Blockchain Technology (Iansiti & Lakhani, 2017)

The Degree of Complexity and Coordination refers to the efforts[15] required to ensure that the application works, while the Degree of Novelty refers to the degree to which an application is new to the world (Iansiti & Lakhani, 2017). The more novel an application is, the more effort will be required to educate users as to how it works, and what problems it solves (Iansiti & Lakhani, 2017).

When mapping the Degree of Complexity and Coordination against the Degree of Novelty of the various applications of blockchain technology, four categories can be developed namely, Single Use, Localisation, Substitution and Transformation (Iansiti & Lakhani, 2017).

Single Use refers to low novelty and low coordination applications that create more effective, highly focused and cost-effective solutions (Iansiti & Lakhani, 2017). Bitcoin can be listed an example of Single Use applications, due to the fact that during its formative years it was used by few, simply as an alternative payment method (Iansiti & Lakhani, 2017). However, by 2016 the value of bitcoin transactions grew to a total $400tr (Iansiti & Lakhani, 2017). As a result, Bitcoin (or any other Cryptocurrency for that matter) has the potential to disrupt conventional currencies as a medium of exchange, where the present financial system has limitations regarding instant payments, foreign currency and asset trading (Iansiti & Lakhani, 2017).

Localisation refers to applications that are relatively high in the Degree of Novelty and have a low Degree of Complexity and Coordination (Iansiti & Lakhani, 2017). Given the limited number of users required to

15 Effort refers to the financial, administrative, regulatory and societal requirements need to realise the applications etc.

create value, the adoption of blockchain technology and related applications can be initially seen in the financial services sector (Iansiti & Lakhani, 2017). The majority of the private blockchain-based development is evident in the financial services sector, with private Fintech firms offering solutions to financial services institutions (Iansiti & Lakhani, 2017). One can anticipate high-volume development of private blockchains to service a number of industries (Iansiti & Lakhani, 2017). In terms of this paper, focus will be placed on the Localisation category of blockchain applications to better understand when Sovereign/Private Ledgers will move beyond conceptual testing and piloting towards full-scale implementation and mass adoption.

Substitution refers to applications which have a low Degree of Novelty, and require a high level of Complexity and Coordination (Iansiti & Lakhani, 2017). Applications within the Substitution category aim to replace the traditional way of conducting business however, they face high barriers to adoption to due to the fact that the systems they seek to replace are embedded deeply in the organisation's processes (Iansiti & Lakhani, 2017). These legacy systems prevent mass adoption as a result, of friction with new technologies/ applications (Iansiti & Lakhani, 2017).

Lastly, Transformation speaks to the blockchain applications that have a high Degree of Novelty and a high Degree of Complexity and Coordination (Iansiti & Lakhani, 2017). According to Iansiti and Lakhani, these applications could change the order of the economic, social and political systems (Iansiti & Lakhani, 2017). Further to this, these applications are reliant on the coordination of many stakeholders to align on processes and standards, as a result, their adoption will require significant regulatory, political, economic and social change (Iansiti & Lakhani, 2017). Iansiti and Lakhani refer to “smart contracts” or “self-executing contracts” as an example of a high novelty-high complexity application that can leverage blockchain’s peer-to-peer distributed network (Iansiti & Lakhani, 2017). Traditionally, business and commerce are founded on contracts (Iansiti & Lakhani, 2017). The development of smart contracts will have significant implications for lawyers, accountants and even managers to a certain extent (Iansiti & Lakhani, 2017). However, given the high complexity and coordination, system-wide implementation of these applications requires a high level of buy-in between major stakeholders, as well as strong consideration around regulatory challenges (Iansiti & Lakhani, 2017). With that in mind, Iansiti and Lakhani believe applications of this nature are still a far way off (Iansiti & Lakhani, 2017).

In summary, Iansiti and Lakhani believe that the adoption of blockchain applications can be explained by the regulatory and stakeholder challenges it may face and the intricacies around what the application can do or be used for (Iansiti & Lakhani, 2017). As a result, the framework postulates that the adoption of blockchain technology follows a path of Single Use, Localisation, Substitution and Transformation, with a focus on applications that have a low Degree of Complexity and Coordination being implemented first (i.e. Single Use and Localisation applications) followed by applications that have a Degree of Complexity and Coordination (i.e. Substitution and Transformation applications) (Iansiti & Lakhani, 2017). While blockchain technology can have a huge impact on the way business-as-usual is conducted in the banking environment,

implementation of a Sovereign/ Private Ledger will require more effort to educate users on how it works, what problems it solves and its potential benefits (Iansiti & Lakhani, 2017).

7. Research methodology

The research paradigm used to address the problem statement put forward in the research report is underpinned by qualitative research methods. Given the nature of the research question and problem statement, a qualitative design was best suited for the study (Hsieh & Shannon, 2005). The research methodology leveraged an interpretive research approach whereby insights, tacit knowledge and the key perspectives related to the study were drawn out during focus interviews and strategic conversations with subject matter experts (Khazanchi & Munkvold, 2002). Further to this, the qualitative research paradigm, specifically interpretive, helped provide more insight into solving the problem statement due to the fact that the study lent itself to being foundational and exploratory research, as the impact of blockchain technology in the South African banking context is not well-defined (Khazanchi & Munkvold, 2002). A semi-structured interview questionnaire was used to guide the focus interview and discussions with the participants and focus was placed on asking open-ended questions linked to the literature review and the research question. During the research study, ten (10) respondents participated. The study involved using Thematic analysis to group, code and theme the qualitative data based on similar features or descriptors from strategic discussion (focus interviews) held with the participants (Braun & Clarke, 2006).

8. Findings and Managerial Implications

The focus of the paper will now shift towards highlighting the outcomes of the strategic conversations with key stakeholders and subject matter experts. The key themes that emerged from the engagements with the respondents from the study will be described, and linked back to the problem statement/ research question. Further to this, the findings from the strategic discussions conducted with the respondents have been superimposed into a 2x2 matrix, and will shed light on how and when blockchain technology will impact the South African banking environment. As a result, the thematic analysis will put forward the outcomes of the research and discussion, while the 2x2 matrix will synthesise and interpret the data.

8.1. Thematic Analysis

Three key themes have emerged from the discussion with the respondents during the field study specifically, Blockchain Applications Considerations, Adoption Rate Considerations and Framework for Adoption of blockchain technology in the South African baking environment. The focus of the paper will shift to describing and unpacking each of the themes.

8.1.1. Blockchain Application Considerations

The first theme that emerged from the engagements during the field study is Blockchain Application Considerations. This theme references the various applications of blockchain technology that can be used by South African banks which will impact day-to-day operations. What must be noted is that each of the applications put forward vary in terms of the impact to the traditional banking model used by South African banks. Therefore, given that blockchain technology is a foundational technology, the extent of its impact on South African banks is dependent on the underlying applications which can be leveraged by the banks. Five underlying applications related to blockchain applications were identified during the field study that can impact the South African banking environment specifically, Internal Private Digital Ledgers (Low Volume Transactions), Internal Private Digital Ledgers (High Volume Transactions), Smart Contracts, Private Distributed Digital Ledger maintained between South Africa's major banks and BankservAfrica and South African Token/ Cryptocurrency (i.e. ZAR Coin). A detailed description of the applications and their impact on the banking environment is outlined in Table 1 below.

Table 1: Impact of Blockchain Technology on the South African Banking Environment

Blockchain technology application	**Description**	**Impact on the traditional banking functions**
a) Internal Private Digital Ledger used for low volume transactions	• Blockchain based ledger that can store information on an internal network within a single bank	• A large focus is placed on the storage and reference functionalities of blockchain technology which will impact banks' storage function • Enhanced KYC control through storage of constitutional documents • Reduced KYC compliance costs (administrative and penalty related) • Storage and management of digital assets (i.e. title deeds, vehicle registration documents etc.) • Enhancement of custodial services offered by banks
b) Internal Private Digital Ledger used for high volume transactions	• Blockchain based ledger that captures, processes and stores transactions, as well as information on an internal network within a single bank	• Focus is placed on using blockchain applications to enhance the value storage and value transaction functions of banks • Enhanced KYC control through storage of constitutional documents • Reduced KYC compliance costs (administrative and penalty related) • Storage and management of digital assets (i.e. title deeds, vehicle registration documents etc.) • Enhancement of custodial services offered by banks • Improved settlement times and visibility of local[16] bank transactions • Reduced fraud, theft and maladministration of funds • Improved oversight and visibility for all transactions

16 Local bank transactions refers to transactions between accounts with the same bank i.e. transfer of funds from one account to the next within the same bank

Blockchain technology application	Description	Impact on the traditional banking functions
c) Smart Contracts	• Blockchain based self-correcting and updating contracts which enable value provision and value protection (loans and insurance)	• Focus is placed on using blockchain application to improve the value provision and value protection functions of banks • Improved intelligence and understanding of risk related to value provision and protection (specifically, customer history and track record) because of improved KYC. Improved insight into the credit worthiness of customers via the track record and history captured on a blockchain[17] • Improved settlement times of loans. Smart contracts will enable banks to transfer asset between themselves and enable syndicated loans to customer in a more efficient fashion • Smart contracts will also enable the value protection in the form of credit guarantees in a more efficient manner with less administrative costs • Reduction in costs related to the risk of value provision and protection • Reduction in administrative costs related to contract maintenance
d) Private Distributed Digital Ledger maintained by South Africa's major banks and BankservAfrica[18]	• Blockchain based ledger that captures, processes and stores transactions, as well as information on a distributed network between BankservAfrica and South Africa's major banks	• A large focus is placed on the storage and transaction applications of blockchain technology which will largely impact banks' storage and value transfer functions • Enhanced KYC control through storage of constitutional documents • Storage and management of digital assets (i.e. title deeds, vehicle registration documents etc.) • Reduced fraud, theft and maladministration of funds • Improved settlement times and visibility of local and interbank payments • Reduction of cost for processing and clearing transactions • Enhancement of custodial services offered by banks • Improved oversight and visibility for all transactions
e) South African Token/ Cryptocurrency (i.e. ZAR Coin)	• Blockchain based South African Cryptocurrency[19]	• Focus on using blockchain applications as a medium of exchange • South African banks will essentially become providers of crypto-wallets and store security keys which will be issued to customer to access their Crypto-assets (Cryptocurrency and various other assets i.e. title deeds, vehicle registration documents etc. on a blockchain) • Further to this, Cryptocurrency will offer enhanced storage of value • Reduced risk related to the storage of funds • Reduction in the cost for processing and clearing transactions • Significantly reduced number of retail branches

17 Can be captured on Hyper Ledger blockchain or Ethereum blockchains

18 BankservAfrica is Africa's largest automated clearing house which enables interbank payments and process transactions. BankservAfrica serves as the trusted intermediary between all banks in the South Africa

19 The Cryptocurrency will be issued by the SARB and will entail migrating all value in South African from fiat currency (i.e. ZAR) to digital currency (i.e. ZAR Coin). The coin will be based on a private blockchain maintained by the large South African banks and the SARB

8.1.2. Adoption Rate Considerations

The second theme that emerged from the engagements during the field study is Adoption Rate Considerations. This theme references the rate at which the various blockchain applications will be adopted by South African banks. Further to this, the adoption rate of each of the blockchain application put forward earlier in the paper have varying degrees of stakeholder coordination requirements, require varying levels of customer education/ buy-in and face friction from existing/ legacy technologies within banks. The adoption rate of the various blockchain applications is explained in Table 2 below.

Table 2: Adoption Rate of Blockchain Technology in the South African Banking environment

Blockchain technology application	Description	Factors affecting adoption by South African banks	Adoption rate[20]
a) Internal Private Digital Ledger used for low volume transactions	• Blockchain based ledger that can store information on an internal network within a single bank	• Mass adoption within the South African banking industry can be realised within five years • Further to this, mass adoption of private blockchain ledgers will be compounded by blockchain solutions offered by Fintechs, and the banks within the west (i.e. USA and Europe). This will force, South African banks to follow suit in an effort to remain competitive/relevant • Limited stakeholder coordination and syndication is required with regards to implementing blockchain infrastructure for storage purpose within a single bank • Further to this, limited customer buy-in/ effort required on educating the customer on the technology innovation due to the fact that it used as a storage medium • Lastly, limited friction may be experienced from existing technology with respect to implementing the blockchain onto a serve/cloud based platform	• High rate of adoption of Internal Private Digital Ledgers for low volumes transactions

20 Adoption rate refers to the perceptive time period in which the various blockchain application put forward will be adopted South African banks. The adoption is a function level of stakeholder coordination, customer education and buy-in and the level of friction of existing/ legacy technologies.

Blockchain technology application	Description	Factors affecting adoption by South African banks	Adoption rate
b) Internal Private Digital Ledger used for high volume transactions	• Blockchain based ledger that captures, processes and stores transactions, as well as information on an internal network within a single bank	• Limited stakeholder coordination and syndication is required with regards to implementing blockchain infrastructure for storage purposes within a single bank • Further to this, a moderate level of effort is required to educate customers on the technology, what problems it solves and the related benefits • Lastly, a moderate level of friction may be experienced from existing technology with respect to implementing the blockchain onto a serve/cloud based platform	• Moderate- to-High level of impact on the South African banking environment
c) Smart Contracts	• Blockchain based self-correcting and updating contracts which enable value provision and value protection (loans and insurance)	• Mass adoption within the South African banking industry can be realised within 10 years • However, mass adoption of Smart Contracts will be exacerbated by Smart Contract solutions offered by Fintechs, and the banks within the west (i.e. USA and Europe). This will force, South African banks to follow suit in an effort to remain competitive/relevant • High level of coordination between stakeholders (Financial services regulators, banks, suppliers/ businesses and end customers) is required • Further to this, a high-level effort is required to educate customers on the concept of Smart Contracts and how it is supported by blockchain technology, what problems it solves and its related benefits • Lastly, a high level of friction may be experienced from existing technologies with respect to implementing introducing smart contracts into the South African banking environment	• Moderate-to-Low rate of adoption of Smart Contracts
d) Private Distributed Ledger maintained by South Africa's major banks and BankservAfrica	• Blockchain based ledger that captures, processes and stores transactions, as well as information on a distributed network between BankservAfrica and South Africa's major banks	• Mass adoption within the South African banking industry will take more than 10 years to realise • However, adoption a will be stimulated by Fintechs entering the market and providing the same solutions in a more efficient and cost-effective manner. This may result, in BankservAfrica adopting a blockchain technology solution sooner than anticipated • High level of coordination between stakeholders (SARB, financial services regulators, BankservAfrica, banks, suppliers/ businesses and end customers required)	• Low adoption rate of a Private Distributed Ledger maintained by South Africa's major banks and BankservAfrica

Blockchain technology application	Description	Factors affecting adoption by South African banks	Adoption rate
d) Private Distributed Ledger maintained by South Africa's major banks and BankservAfrica	• Blockchain based ledger that captures, processes and stores transactions, as well as information on a distributed network between BankservAfrica and South Africa's major banks	• Further to this, a moderate level of effort is required to educate customers on the technology, what problems it solves and its related benefits • Lastly, a high level of friction may be experienced from existing technology/ processes with respect to implementing a digitally distributed blockchain solution (i.e. Friction from BankservAfrica, SWIFT etc.)	• Low adoption rate of a Private Distributed Ledger maintained by South Africa's major banks and BankservAfrica
e) South African Token/ Cryptocurrency (i.e. ZAR Coin)	• Blockchain based South African Cryptocurrency	• Mass adoption within the South African banking industry will take in more than 10 years to realise • The establishment of a central bank issued Cryptocurrency, is likely more conceptual and highly improbable at this stage in South Africa. Given South Africa's political and socio-economic context and the loss of financial and policy controls (monetary), complete migration towards a South African digital currency is not plausible • Very high level of coordination between stakeholders (Government, SARB, financial services regulators, banks, suppliers/ businesses and end customers is required) • Further to this, a high level of effort is required to educate customers on Cryptocurrency, what problems it solves and the related benefits of migrating to Cryptocurrency and what it will mean • Lastly, a high level of friction will be experienced migrating away from traditional fiat currency to Cryptocurrency. This is due to the limited control the SARB and government will have over the Cryptocurrency once established and mined	• Low adoption rate of South African Token/ Cryptocurrency (i.e. ZAR Coin)

8.1.3. Framework for adoption of blockchain technology in the South African banking environment

The third and final theme that emerged from the engagements during the field study is the Framework for Adoption of blockchain technology in the South African banking environment. This theme provides a framework for understanding the effect of blockchain technology on the South African banking industry. The framework maps the Impact of blockchain technology on South African banks against the Adoption rate of blockchain technology by South African banks and gives rise to four strategic scenarios and what they mean for the banking environment specifically, Traditional Banking, Conservative Application Banking, Transformed Application Banking and Crypto-Application Banking. The four scenarios are outlined in Figure 2 below.

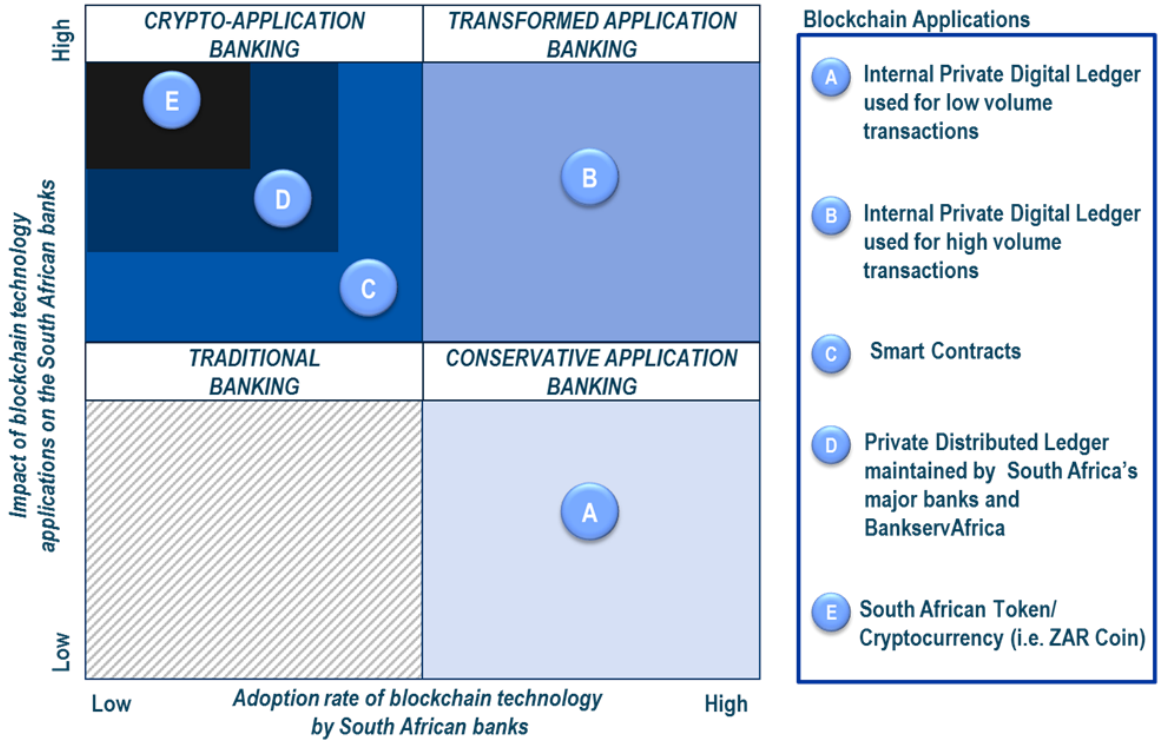

Figure 2: Framework for understanding the effect of blockchain technology on the South African banking environment

Traditional Banking is characterised by a low/no Adoption rate of blockchain technology by South African banks and a therefore a low Impact of blockchain technology applications on South African banks. This scenario assumes that banks will not adopt any form of blockchain technology and will leverage current banking systems and processes.

The largest challenge related to not adopting blockchain technology or integrating into the banking system lies in the fact that the bank will be at risk of being disrupted from Fintechs, or various other banks that leverage the technology. Given the fact that the banking industry within South Africa has a short innovation cycle which is underpinned by technology, it is recommended that South African banks avoid this approach and investigate various use cases and applications of blockchain technology to enhance its business.

The Conservative Application Banking scenario is characterised by a high Adoption rate of blockchain technology by South African banks but a low Impact of blockchain technology applications on South African banks. This scenario assumes that SA banks will leverage blockchain technology in its most elementary form, a Private Digital Ledger targeted at low volume transactions. Applications of blockchain technology in this manner will allow banks to improve KYC processes (and thereby reduce risk and penalties for non-compliance), but also a store of value for non-monetary assets (i.e. vehicle registration, title deeds, custodial services etc.). Banks are most likely to adopt this form of functionality in the short-term before looking to more radical or innovative applications.

Speaking to Transformed Banking, this scenario is characterised by a high Adoption rate of blockchain technology, coupled with a high Impact of blockchain technology applications on South African banks. This scenario assumes that SA banks will leverage blockchain technology as more than just a storage medium, but a Private Digital Ledger for high volume local[21] transactions. Migration towards the use of this blockchain application is likely to be realised in the short-term (less than five years) given limited friction with current systems and effort required to educate end customers. This will result in banking being more efficient, cost effective with less risk. Banks that substitute towards this blockchain application are likely to be at the forefront of the technology and innovation cycle within the SA banking industry.

Lastly, Crytpo-Banking speaks to a low Adoption rate of blockchain technology, coupled with a high Impact of blockchain technology applications on South African banks. This scenario is categorised by the more radical applications of blockchain being leveraged in the South African banking industry, specifically, Private Distributed Digital ledger between BankservAfrica and the large banks in South Africa, Smart Contracts and South African Token/ Cryptocurrency. While these applications are revolutionary and can dramatically reduce the cost and risk of banking while improving efficiency of the banking process, there is a large level of stakeholder coordination, significant customer education required and a high level of friction that will be experienced. As a result, these types of innovation are still a long way off and could possibly only be realised in the long term (more than 10 years).

9. Limitations of the study and future possible research

The study has its limitations and setbacks in the form of its methodology, sampling method and data analysis and interpretation. Given that the research method is qualitative by nature, the findings from the research may be impacted by a high level of subjectivity and bias. While more insight into various areas of the study will be gained, data can be impacted by opinion. The sample of the study is relatively small and may not be reflective of the entire banking industry in South Africa. While experts within the blockchain and banking industry will be engaged, their views may not necessarily be reflective of the entire industry. Thematic analysis is the preferred tool for analysis when it comes to qualitative research, it too can lend itself to a high level of subjectivity, given that it is interpretive. However, if carried out correctly, the outcomes and findings from the research can be used as a platform to prompt further analysis to quantify effect of blockchain technology on the South African banking environment.

10. Conclusion

While blockchain technology can have a positive impact on the South African banking system, the technology ecosystem, stakeholder environment and regulatory environment needs to be considered when

[21] Local refers to non-interbank transactions

adopting it for use into the South African banking environment. As a result, a path of conservative adoption followed by mass/ rapid adoption will be followed by South African banks, with Private Digital Ledgers the most likely application to be integrated into South African banking environment in the short term and more radical applications (i.e. smart contracts, tokens etc.) adopted in the long-term. From a qualitative perspective, this study highlights the impact of blockchain technology on the South African environment and positions itself as a platform for further research into the effect of Private Digital Ledgers (based on blockchain technology) on the South African banking environment. Therefore, to enhance the outcomes of this study, further research into the quantitative impact of Private Digital Ledgers on South African banks is required.

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