An analysis of the outlook for Blockchain technology in the South African banking industry

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Abstract

Banking has been a part of humanity's expansion and geographic migration for millennia, and whilst our methods of banking has evolved significantly since historic times, there are still pockets of the value chain which remain almost as archaic as the dawn of modern banking in the 14th century. The concept of keeping track of the global banks (and hence the worlds) money has been one which has required teams of people, and copious amounts of duplicative reconciliations since before the invention of the dual-entry ledger. In addition, given the need for trusted intermediaries in the global financial market, convoluted and often, expensive transaction paths have arisen. To compound matters, post the Global Financial Crisis of 2008/09, the financial sector has experienced a significant deterioration of its social capital with the public – resulting in an unprecedented percentage of the global population seeking alternatives to traditional banking practices.

In this regard, blockchain technology has risen to prominence in the past two years, as the technology underpinning the cryptocurrency, Bitcoin. The cryptocurrency has promised – and to a large extent delivered, an alternative to cross-border transactions via the banks. In addition, by negating the need for a single (or group of) trusted intermediaries, the technology has been presented as a "silver-bullet" to the worlds distrust of the banks.

This research, which was qualitative in nature, was conducted via semi-structured interviews with knowledgeable individuals within the South African banking sector. These included members from all four of the largest South African banks as well as other related stakeholders in the industry. The research found that research and development of blockchains (in various forms and for various functions) is prevalent in the industry, and in some cases, has been quite well supported across the industry players. The research describes the opinions and perspectives of how the South African banks intend to utilise the technology, as well as presented the constraints and threats to existing business practices. The research found that blockchain technology has gained enough momentum to move past being a "passing fad", and that there are strong convictions amongst the banks that the technology will be one of the strongest contenders to disrupt the traditional banking value chain in many segments.

DECLARATION

I, Avishkar Brijmohun, declare that this research report 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 University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

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Avish Brijmohun

10 September 2017

Dedication

This research is dedicated to:

my parents, who provided the structure and values upon which to grow,

my family, who are the ones who tolerated, and fostered my innate curiosity,

my friends, who provided me with the encouragement to seek the answers to all my questions,

and finally to my wife Sunira, for being the strong centre around which

my ever-increasing ambitions

gravitate.

Acknowledgements

This research would not be possible without the open and honest discussions I had with the South African banking sectors respondents. Thank you to all participants and friends who opened up your networks to me – that made the difference to the research. The final thank you goes to Tershia Kruger for your patience and understanding during this entire MBA process, your guidance and indulgence was truly appreciated in this entire process.

Table of Contents

1. Introduction

1.1. Purpose of study

The purpose of this research is to collate the opinions of the South African banking industry on the applications for blockchain technology and their thoughts on its impact on existing – and potential banking revenue streams.

1.2. Context of the research

For a number of years, the world's banking industry has been content to capitalize on it's existing value chains and processes, with relatively little being spent on research and development (Pizzala & Webster, 2015). The rationale for this was defendable to an extent – regulations made the barriers to entry very high and parallel banking competitors such as peer-to-peer lenders were quite small. (Pizzala & Webster, 2015). This state of inertia however was seen to be disrupted in the late 2000's, with the initially gradual rise of companies focused on technology solutions specifically for the financial sector. The financial sector can be broadly defined as consisting of banking, insurance and asset management companies (amongst others). These companies are now referred to as "fintech" companies. (Pizzala & Webster, 2015)

In 2009/10, the gradual growth in the number of these fintech companies gave way to a relative explosion of new companies (Pizzala & Webster, 2015). It was no coincidence that this explosion took place after the turmoil experienced by the world's economy in the 2008/09 Global Financial Crisis. The global banking sector was seen to be the root cause of this economic turmoil and thus the banks experienced a significant erosion of the public's trust. In this environment, technology start-ups began looking at ways of conducting business whilst partially or completely bypassing the formal financial industry. And the seed capital to pursue these ventures closely followed this rising sector (Pizzala & Webster, 2015).

By 2014, Pizzala & Webster (2015) estimated that investments into fintech ventures had tripled to $12.21bn on the year before. Their report further expects that amount to exponentially increase as "market confidence in the ability of digital start-ups to disrupt the banking market increases". Whilst a significant portion of this expenditure can be attributed to global technology giants such as Tencent, Samsung and Apple, there is still a large portion of the funds flowing to the "Silicon" hubs of the world, led by the USA (Pizzala & Webster, 2015).

Fintech as a category however, is quite broad. The field encompasses everything from wallet-less payments which are attempting to cut out the need for complex credit card transaction clearing

institutions, to robo-advisers which are aimed at reducing the need for human contact when making investment decisions. If one researches fintech enough however, a particular form of technology repeatedly – and increasingly comes up, that being "blockchain" technology. The blockchain is most popularly known for it's use in the Bitcoin digital currency – a form of cryptocurrency. In a sense, Lee (2015) considers cryptocurrency as simply the next evolution of the normal digital currencies which have been used by South African companies for close to two decades (such as FNB's ebucks program).

It is however, the technology behind bitcoin which has begun to capture the imagination – and capital of fintech companies and banks (Finextra, 2016). This technology is called the "Blockchain", and it allows the facilitation of the secure transfer of data from one party to another without a central clearing house to stand on either side of the transaction (Lee, 2015). This allows the transactions to take place, without a central institute having to maintain, and update their individual ledgers. Instead, the process to verify a transaction is done via consensus confirmations on a "distributed" ledger, that no one individual institute needs to maintain (Lee, 2015).

In blockchains, every user on that particular blockchain sees an encoded version of the transaction, and has to engage in complex calculations to "prove" that the transaction is legitimate (Lee, 2015). In essence, 51% of users are simply solving a highly complex mathematical equation to confirm that the purchaser actually had adequate bitcoin with which to pay. As every user can see and decode the transaction, the need for an approving central party is eliminated, and thus allows the entire system/blockchain to become "trustless" (Lee, 2015).

As revolutionary as Bitcoin is, there is growing acknowledgment that blockchain technology can be the backbone of numerous other trustless processes and applications (Foroglou & Tsilidou, 2015). A recent report on blockchain in capital markets by Van de Velde et al. (2016) of Oliver Wyman and Euroclear (2016) puts forward a compelling argument that this is set to change as banks and other fintech companies explore new methods of data management and sharing in a bid to circumnavigate the frictional inefficiencies of the financial industry (Van de Velde, et al., 2016).

However, the report shares many of the same opinions expressed in the research conducted by (Pilkington, 2015) in that wide-spread adoption is unlikely to be accomplished across the industry in the next 24 months. Both Pilkington (2015) and Van de Velde (2016) expect that the meaningful next steps in the blockchain development will be in the capital market segments of the banking industry given the large value trades which take place in this segment – and the costs involved to conduct trades in this market given the current necessity of clearing and brokerage houses (Pilkington, 2015;

Van de Velde, et al., 2016). The benefits of the technology include a reduced transaction time, reduced counterparty credit capital (due to reduced transaction time), lower collateral requirements, decreased reconciliations and thus lower accounting costs, reduced risk of process error if automated “smart” contracts are used and many others (Pilkington, 2015).

The aspects which were not covered in adequate detail surrounded the costs of implementing the blockchain applications, and the operational complexities of linking these new systems to legacy systems. In addition, whilst it is likely that new software development talent will naturally be attracted to the technology, the implications of their gaps in knowledge and thus lag-times between inception and delivery is a concern which has been discussed relatively lightly.

On a longer time frame, Pilkington (2015) further elaborates on the expectation that financial and other institutions will begin to use the blockchain to replace traditional ledgers and asset registries. This has the potential to increase the credit-worthiness of the global SME segment given increased collateral from these types of collateral/asset registries (IFC, 2015). However Van de Velde (2016) importantly states that “In order to shape a new future, the industry needs to take a collective view on the potential of the technology” and that “It is up to major established players in the market to work with innovators to develop standards, while also preserving the existing strengths of the ecosystem, and navigating the complex worlds of regulation and legal oversight” (Van de Velde, et al., 2016).

Given this last statement, it has become clear that whether the South African banks initiate it or not, their input and buy-in will be a necessary part of any widespread blockchain adoption in the industry. The increase in research and development spend on fintech applications (in South Africa) is evidence that mind-sets are changing (Mgabadeli, 2016). It now remains to be seen whether the South African industry will be early adopters or laggards in the field (Mgabadeli, 2016).

The study aims to address the business problem of a small body of knowledge in the South African banking industry, and to ascertain the potential for use-cases and revenue pools for blockchain in the future. The research focused on the commercial and merchant banking segments of the banking industry as it is the segments of the industry with the largest revenue pools (Finextra, 2016). It is hoped that the insights from this research will assist the growth in the blockchain development by establishing some certainty, direction and optionality for the technology by both the incumbents and the challenger fintech companies.

1.3 Problem statement

1.3.1. Main problem statement

To understand the extent to which the South African banking sector is anticipating changes to it's processes and revenue streams given blockchain technology implementations.

1.3.2. Sub problem statement 1

To ascertain the banking sector's perceptions of how blockchain will impact on existing – or future banking revenue streams

1.3.2. Sub problem statement 2

To understand the actions being taken to adopt, ignore or react to blockchain technology

1.4 Significance of the study

Whilst there has been a significant amount of research conducted on the impact of fintech on banking in the developed markets of the United States and Europe, there has been a relatively small amount of research conducted in the South African banking context. This is emphasised in an IBM report which discusses the fact that whilst broader fintech is undoubtedly having an impact on the financial industry, blockchain is "still in it's relative infancy" within the banking industry (Finextra, 2016)

Research from the South African banks media releases show that they are beginning to scale up their fintech software and programming capabilities in order to compete against, or adopt the latest fintech coming up from global technology hubs in their service offerings (Finextra, 2016). This however, again seems to be focused on the payments space, with the exception of ABSA who has been seen to be focusing on blockchain applications (Finextra, 2016).

This study intends to focus on blockchain applications in the South African banking space given the expected rise in use cases in the near future (Finextra, 2016). The basis of this expectation is the increase in fintech companies globally who are specifically focusing on blockchain applications. Whilst there is interest in the topic, it has been said that a "critical mass" of interest in the blockchain has not yet been reached in South Africa to push more South African fintech companies into developing blockchain solutions (Finextra, 2016). This has in part been due to an opaque relationship between the banks and fintech companies, resulting in uncertainty of the potential size of the blockchain industry (Finextra, 2016; Pizzala & Webster, 2015).

This study aims to provide the South African banking industry and fintech companies with a collated view of the banking industry's perceptions of blockchain technology and the potential for use cases

and future revenue pools. The aim is to generate insight into the topic for the banking C-suite to further understand the technology's potential. This is intended to encourage discussion of blockchain within the banking sector, with the aim to further develop the fintech scope and industry as a whole. The hope is that the banks will use this research to encourage further research and development within itself to better support the goal of keeping up with – or leading the international banks on blockchain innovations.

1.5 Delimitations of the study

- This study specifically focuses on blockchain technology and not fintech in general,
- The banking sector was chosen for this study, and specifically excludes the companies in the larger financial industry such as the insurance companies etc.
- The study looks at South African banks, and thus caution should be applied when extrapolating to the broader banking industry
- The study attempts to understand the impact on the South African banking experience/processes and thus caution should be applied when extrapolating to the other country's banking sector (even within the African continent)
- This study is intended to relate specifically to the broader blockchain technology, and not only on Bitcoin applications.

1.6 Definition of terms

Bitcoin	Digital currency started in 2009 by Satoshi Nakamoto is currently the most widely adopted blockchain-based digital currency in use.
Blockchain	A public ledger in which every block can be likened to a page in a traditional ledger. Each block connects to the previous block in order to form a one chain from the very first block/transaction to the present day.
Capital market	The market in which companies enter to raise debt or equity capital for purposes of funding their businesses. Examples include the stock and bond exchanges
Clearing house	A central party responsible for the verification and settling of transactions between two known or unknown counterparties. E.g. SWIFT
Cryptocurrency	A digital currency which has enhanced security features using cryptography
Cryptography	A form of mathematics involving codes and ciphers created in order to encrypt (secure) information.
Fiat currency	Currency which is legal tender whose value is backed by the government that

	issued it, such as bank notes and coins
Fintech	Financial technology solutions developed to compete against traditional banking services
Fintech incubator	A physical location which brings together start-ups/entrepreneurs and interested parties together to develop fintech solutions
Peer-to-peer lending	A form of lending which bypasses the traditional banking system by bringing together funders and borrowers on an online platform
Seed capital	Initial funding from venture capitalists to begin the venture in exchange for an equity stake in the business

1.7 Assumptions

The following assumptions were made with respect to the research:

- Blockchain technology is a viable technology format
- There is interest in the subject by the individuals interviewed
- The individuals interviewed in this study have sufficient experience of the current banking industry and processes. A minimum of three years banking experience was deemed adequately knowledgeable.
- Interviewees have a level of knowledge of blockchain technology so as to make a generalisation of the banking industry from a small sample size
- The researcher would be able to gain access to individuals knowledgeable about blockchain
- The interviewees would be willing to share their thoughts on blockchain
- Given that the South African banking industry is made up of a small number of banks, interviews at four of the banks could be representative of the greater industry
- The researcher would not share any sensitive information that interviewees provided

2. Literature review

2.1. Introduction

This literary review intends to introduce the major aspects of, and the trends within the blockchain environment. Studies that have been published on the topic will be analysed as part of this chapter. Despite substantial research, there seems to be a larger pool of research on blockchain applications from and about the markets outside of South Africa. The literature available specifically for the South African context appears to be far fewer at the time of research. This is to be expected however given that, with the exception of Bitcoin, blockchain has been in the mainstream for a relatively short period of time. In addition, the fact that both the South African technology and venture capital industry is small (relative to developed countries), plays a role in the relatively slow pace of blockchain technology research that was conducted in the country until quite recently.

To achieve a good understanding of Blockchain, it is imperative to break down the concept into a few sub-segments. Accordingly, this literary review is split into four such sub-segments. The first segment of this chapter will provide a historic perspective on the development of the financial transaction and economic environment which allowed a rise of blockchain technology. Secondly, a detailed, but non-technical description of how the blockchain operates, and a comparison between the existing and proposed financial transaction process is discussed. Thereafter, the third segment will discuss the opinions and literature of academics and subject-matter experts focused on expected global blockchain trends. In the fourth segment, a review of the impact of blockchain technology specifically on banking to date is presented, which will include the factors currently influencing the banking industry and the associated trends being observed therein. Finally, the literature review will conclude with the key research question for this study.

2.2. The history of financial transactions

Whilst Blockchain is beginning to experience a plethora of use-cases in many different industries, the financial sector is the sector which has the highest potential for disintermediation (Pilkington, 2015). The understanding of how economic transactions have changed between counterparties is at the very core of this disintermediation and thus this research begins with a review of this development.

Monetary transactions have taken place for thousands of years. These began with various items, such as difficult-to-procure sea shells, being used as a “store of value” for commodity or service exchanges (Daychopan, 2016). As coins made of rare metals began being used as the leading form of exchange, there was a requirement for the set-up of institutions to ensure the credibility of these exchanges (Daychopan, 2016). The rationale for the need of institutional credibility was quite

straight-forward - as one begins to interact with a counterparty beyond your immediate social circle, the level of trust in one's counterparty decreases (compared to trust in one's nuclear family for example) (MacDonald, Allen, & Potts, 2016). Thus, as early civilizations grew, they found themselves able to trade with other parts of the city, kingdom and even other countries. Basic questions of whether a coin from a different country contained enough gold, or even whether the coin – and counterparty, was legitimate became important (Daychopan, 2016). Thus institutions such as the treasuries of ancient cities, and over time, commercial banks became a common and trusted third party intermediary that stood on either side of the financial transaction (MacDonald, Allen, & Potts, 2016). In addition, knowing that the fiat currency such as the coins (and later notes) were minted and/or stored by a trusted central provider provided a further measure of credibility (MacDonald, Allen, & Potts, 2016).

2.2.1. The control of the value of a currency

In the early days of money, these treasuries were the only entities allowed to mint currency. In theory, by controlling the amount of fiat currency produced, these treasuries protected the value of the currency by keeping it adequately scarce (MacDonald, Allen, & Potts, 2016). This scarcity was initially explicit given that the coins were literally made of rare, and thus difficult-to-procure gold and silver (MacDonald, Allen, & Potts, 2016). When bank-notes were later introduced, they were again linked to (i.e. backed by) an amount of gold (Weber, 2016). Thus the amount of fiat currency in the entire financial system was again limited to the amount of physical gold a country held in their vaults (Weber, 2016). This principle of backing fiat currency with an amount of gold was referred to, in economics, as the "gold standard" (Weber, 2016).

2.2.2. The impact of the 2008/9 Global Financial Crisis

Over time however, for a variety of reasons, the gold standard was discarded (Weber, 2016). This allowed central banks to print money without being constrained by the amount of gold in their vaults (Weber, 2016) – resulting in a large increase in the amount of fiat currency available in the world (Pilkington, 2015). In the 2008/09 Global Financial Crisis (GFC), this increased un-backed currency issuance combined with a number of other factors to threaten the stability of the world's financial system (Pilkington, 2015). There were many actions that central banks used to attempt to prevent a global recession.

The primary actions attempted were the 1) recapitalization of various banking systems via the injection of equity capital (from tax-payer monies), and 2) the printing of large sums of additional money so as to encourage the banks to increase lending and thus attempt to stimulate the world's consumption (Pilkington, 2015). This action has become known as quantitative easing, or "QE" in the economic world (Weber, 2016).

Arguably, the recapitalizations and quantitative easing were successful in staving off an immediate global recession. However an unforeseen consequence of these actions was the erosion of trust in commercial & central banks and in according to some authors, the entire banking system (Pilkington, 2015).

2.3. The entry of Blockchain and Bitcoin

In 2009, this erosion of trust was listed as a partial reason for the creation and publication of a digital "crypto-currency" called Bitcoin (Nakamoto, 2008). Via the use of a technology called Blockchain, Bitcoin's creator(s), Satoshi Nakamoto attempted to provide a means of exchange and payment outside of the traditional banking ecosystem – and thus reduce the necessity of (trusted) third parties in an otherwise two-party transaction (Nakamoto, 2008).

As Bitcoin became increasingly well known, it became clear that Bitcoin itself was not the most interesting aspect of the currency, but rather it was the underlying Blockchain technology that had the greatest use-case potential (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). It was this technology that allowed a transaction to be conducted without a third party intermediary – and thereby bypass the central and commercial banks and other similar payment middlemen, and their attached fees (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016).

2.3.1. Traditional banking transaction paths

For one to understand how Blockchain enables transactions to be conducted without a trusted intermediary, one is required to acknowledge the legacy method of transacting. At the core of this legacy method, once conditions have been met for an exchange of funds (e.g. a purchase of a house) between two counterparties, instructions are sent for funds to flow from the purchaser's to the seller's bank account (MacDonald, Allen, & Potts, 2016). Given that the seller does not know the purchaser, there is a low level of trust between the two counterparties. To remedy this low-trust situation, a trusted third party is introduced that has the reputation and authority to confirm a trade – in this case a bank (MacDonald, Allen, & Potts, 2016). In simpler terms, the buyer and seller substitutes trust in an individual, with trust in a mutually known institution (MacDonald, Allen, & Potts, 2016).

If one had to track the flow of these funds, one would see that there are potentially many intermediaries in between the funds leaving the buyers account and reaching the sellers account (MacDonald, Allen, & Potts, 2016). As an example, if we assume that the seller and buyer bank with different banks, there would need to be an intermediary between the banks themselves as seen in figure 1 below. This is also due to the level of trust being relatively low between banks (MacDonald, Allen, & Potts, 2016). The payment is considered final when, after going via these middlemen, the

seller's bank confirms that the funds have been received from the purchaser's bank – and each banks ledger have been updated (MacDonald, Allen, & Potts, 2016). Whilst providing a level of trust to the seller and buyer, the consequence of these third-parties are 1) significantly increased transaction paths and times, 2) transaction costs at each level of third party interaction and 3) multiple records/ledgers for overlapping transactions (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016).

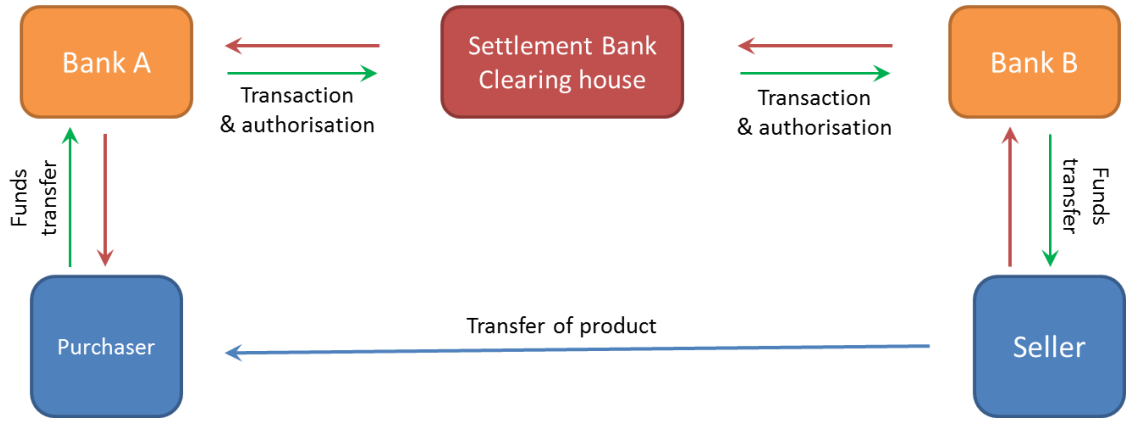

Figure 1: Traditional banking flow of funds (Crosby et al., 2016)

2.3.2. Blockchain's distributed ledgers

The blockchain attempts to cut out the need for third parties (and costs associated) by substituting trust in an institution with trust in cryptography and mathematics (MacDonald, Allen, & Potts, 2016). It does this by removing the need for each third party to maintain their internal ledgers, and replacing those individual ledgers with something that blockchain refers to as a "distributed ledger" (Gifford & Cheng, 2016). This distributed ledger is a live copy of a ledger that is simultaneously held by numerous computers (or "nodes") across the network. Thus each member of the network would receive every transaction update so that every person/node has an identical record/ledger of all transactions (Gifford & Cheng, 2016). A consequence of this distributed ledger concept is that every member's balance is openly available, hence potentially creating a privacy issue (Gifford & Cheng, 2016).

2.3.3. Transacting using blockchain

Blockchain and therein Bitcoin, solves this privacy issue by issuing every user on this network with both a public and a private key with which to conduct transactions (Pilkington, 2015). The public key acts like an account number, which can be sent to other nodes/the public, thereby providing an address to which others can send information/currency to (Driscoll, 2014). The private key can be likened to an ATM pin code (and thus is to be protected) and it is cryptographically linked to one's public key (Driscoll, 2014). When a transaction is required, the sender uses his public key and other

required software to broadcast a message to the entire network. This message contains his and the receiver's public key (i.e. your account numbers), as well as the information/currency that he is sending (Driscoll, 2014). The rest of the network then confirms the transaction is legitimate (discussed further below) and every node updates their version of the distributed ledger with the latest transaction (Pilkington, 2015).

Given the simplicity of broadcasting a transaction message, there exists a possibility that a nefarious user could use another user's account number (public key) to fraudulently transact (Pilkington, 2015). The blockchain technology solves this issue by creating a digital signature. This is accomplished by (simplistically) inputting one's private key and transaction details into a cryptographic function within the blockchain to generate a digital signature which is unique to that specific transaction (Driscoll, 2014).

A different cryptographic function allows other nodes in the network to check the signature and confirm that the transaction was indeed created by the account holder (Driscoll, 2014). This is accomplished by the function confirming the link between the public and private keys, and that the signature is applicable to that specific transaction (Driscoll, 2014). The confirmation of these details proves the legitimacy of the transaction, and is then broadcast to every node in the network. Given that the cryptographic function generates a unique signature for every transaction, it is extremely improbable that these signatures will ever be reused in the future – thereby enhancing the security of the process (Driscoll, 2014).

2.3.4. Challenges with Blockchain-based cryptocurrencies

2.3.4.1. Double spending

Whilst the digital signature increases the security of the entire system by proving ***who*** sent a transaction, they do not prove ***when*** the transaction was transmitted (Pilkington, 2015). Given this, there could be occasions of what is referred to in financial markets as the "double spending" problem (Pilkington, 2015) and is explained below.

One of the strengths of traditional banking's ledgers is that if the purchaser with R1 000 in the account simultaneously issued two R1 000 payments orders to different recipients, the bank would check their internal ledger and only pay-out to the first recipient who "cashed the cheque" – with the second simply being refused payment (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). However in Blockchain's distributed ledger, the transaction is sent to every node's ledger (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016).

If one used a Bitcoin transaction as an example, given internet connectivity (and other) delays, and the global dispersion of computing nodes in the network, a transaction could be received by nodes at different times (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This potentially provides a fraudulent purchaser with the opportunity to send a payment notice to two sellers at the same time. Both sellers could think their transaction was confirmed, and ship their product to the purchaser (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This effectively allows the purchaser to spend the same Bitcoin twice.

Blockchain prevents this double spending from occurring by mathematically providing a method of determining the order of transactions across the network (Pilkington, 2015). As new transactions are created, they enter a pool of pending transactions, and are combined with other transactions and at this stage are referred to as transaction "**Blocks**" (Pilkington, 2015). The confirming of these transactions result in the block being broadcast to the rest of the network that this is the next block of trade that will take place (Pilkington, 2015).

The confirmation process deserves some additional detail for adequate comprehension. From the pool of blocks, nodes on the network select a block of their choice to confirm, using the mathematical functions discussed previously (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This process is colloquially referred to as "mining" and the nodes are referred to as "miners" (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). To incentivise the miners to use their computing power to be the fastest to solve the mathematical function, the Blockchain software rewards the fastest miners with newly generated Bitcoins (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). The result of this is twofold – the miner claims the incentive fee (and introduce new bitcoin into the network), and more importantly, the block gets to be the next transaction processed in a long "**Chain"** of past transactions (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This method of using computing power to link the next block to the chain (i.e. prove the last transaction) is referred to as the "proof of work" for which a reward is warranted (Pilkington, 2015).

The "Block-Chain" is thus effectively simply the historic blocks of transactions which are linked in the order that the blocks were mathematically solved by miners.

2.3.4.2. The security of the blockchain

Given that one of the key aspects being punted by blockchain proponents is that it is almost impossible to alter transactions (Van de Velde, et al., 2016), it is important to understand why proponents believe that this new technology's security is better than the legacy process.

To begin, the mathematical function used to confirm a block (discussed in section 2.3.4.1) is referred to as a "cryptographic hash" function (Driscoll, 2014). In essence, the hash function at it's most basic level simply randomly mixes up the numerical or alphabetical inputs to result in a different set of outputs – and this output is referred to as a "hash" (Driscoll, 2014). The essence of blockchain is that there is no ***easy way*** to start with an output and work back to the input data (Pilkington, 2015). There is however the difficult method of determining the input – by guessing. This guessing is the process which was referred to previously as the mining process (Driscoll, 2014). Mining is thus the process of using the node's computing power to test many different guesses, and thus eventually arrive at the input data (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This is the method used by Bitcoin nodes today to prove that a transaction is legitimate.

Once confirmed, this hash is then combined with the transaction from the block pool (i.e. hash details + public key details), and the last confirmed block of the blockchain (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This thereby links the newly confirmed block to the last confirmed block of the blockchain (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This is illustrated in figure 2 below. The same linking process would have been conducted right from the very first block on the blockchain, thus providing certainty of every transaction that has taken place on that blockchain (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016).

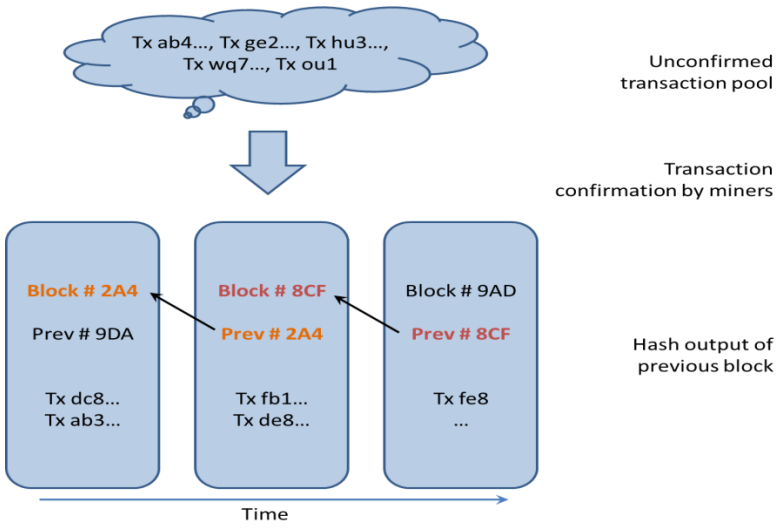

Figure 2: Generation of Blockchain from unconfirmed transactions (Driscoll, 2014)

Given the unique linking mechanism, for a malicious individual to attempt to overwrite one block, would necessitate having to overwrite the preceding blocks all the way back to the very first block (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). Thus, whilst perhaps not entirely

impossible, the computing power, cost and time required to alter the entire chain renders the reward not worth the effort (Driscoll, 2014).

2.3.4.3. The trustless blockchain

To use a Bitcoin example, when an individual joins the bitcoin blockchain, the individual does not simply download a copy of the ledger. This would imply that the individual trusts the anonymous network of nodes that have previously transacted (Driscoll, 2014). Blockchain in essence presents the ability, and encourages, zero trust in anyone but yourself. Instead of trusting that others have sent you a legitimate copy of the distributed ledger, your computer will perform a once-off re-check of every bitcoin transaction that has taken place from the first Bitcoin transaction in 2008 (Driscoll, 2014). Via this process, your computer node would be constructing it's own copy of the distributed ledger – and ensuring that you do not have to trust any of the anonymous nodes on the internet (Driscoll, 2014). The process of checking whether a purchaser has enough bitcoin to pay a seller is similar. On the blockchain, there is no "closing bitcoin balance", instead the nodes will run through every transaction the purchaser has made and recalculates that he has enough unspent bitcoin to make payment to the seller (Driscoll, 2014).

The entire blockchain system is thus referred to as a "trustless" system - when compared to traditional banking and necessary trusted third parties (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016).

2.3.4.4. Determining the correct blockchain

The final challenge with the blockchain that needs to be discussed in this report is the possibility of two or more blockchains stemming from the original blockchain.

As discussed in section 2.3.4.2 above, the blockchain with the longest chain of blocks will be the chain that has had more transactions confirmed to date – and thus your computer can be more confident that it is secure (Crosby, Nachiappan, Pattanayak, Verma, & Kalyanaraman, 2016). This is an important concept as an inherent part of Blockchain's (and therein Bitcoin's) protocol is that new blocks should be added to the longest chain (Nakamoto, 2008). Given that there can be many thousands of nodes working on different blocks at any given time, there is a reasonable probability that two or more blocks are confirmed simultaneously (Driscoll, 2014). Thus both blocks will need to be linked to the blockchain at the same moment. This effectively creates two blockchain paths, with the same legacy blockchain up to the preceding block (Driscoll, 2014). This can be seen in figure 3 below.

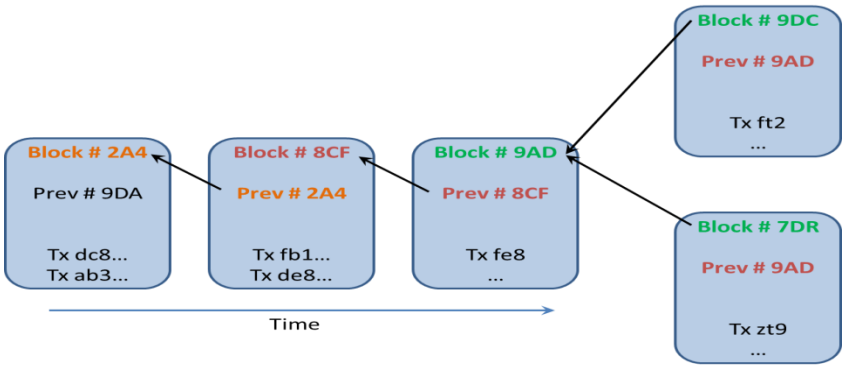

Figure 3: Blockchain transaction ordering (Driscoll, 2014)

This is typically rectified fairly quickly as the following few blocks get linked to one of the two blockchain paths. This longer blockchain path again becomes viewed by the network nodes as the strongest/most secure blockchain, and the blockchain nodes continue with business as usual (Driscoll, 2014). The block which led to the unused chain path simply goes back into the pending transaction block pool to be re-added to the blockchain at a later stage (Driscoll, 2014).

2.3.4.4.1. A 51% attack on a blockchain

This assumption of the longest chain being best of course opens up the debate about whether a single user or consortium of users could work nefariously to confirm many blocks in a row on an alternate blockchain path (Driscoll, 2014). If possible, this would allow the group to extend a particular blockchain for their own self-interest, such as a double spend attack or fraudulent transactions (Driscoll, 2014).

As previously discussed, the blockchain regulates this via its requirement of computing power, and thus electricity cost, to confirm blocks. This, in theory, makes it preventatively expensive for any one person or consortium to expend the electricity to solve enough blocks in a row – before the rest of the blockchain network across the world - to “hijack” a blockchain (Driscoll, 2014). In Bitcoin, this is sort of attack on the blockchain is referred to as a “51% attack”. This can be explained simply as the amount of nodes (i.e. 51% of all nodes) that would be required to statistically stand a meaningful chance of hijacking a blockchain for a long enough series of blocks to double spend or fraudulently transfer Bitcoins to their own accounts (Driscoll, 2014). Even then, the consortium actually still has only a small probability of solving the next block before the rest of the world, and an even lower probability of solving the additional consecutive blocks to create a long enough blockchain path (Nakamoto, 2008).

2.4. Current and expected global blockchain trends

2.4.1. Comparisons to previous technology adoption life cycles

This sub-paragraph begins with a comparison of the blockchain technology life cycle to date, and ends with a discussion of the major companies which are pushing the technology along the adoption life cycle. This was done so as to provide the reader with adequate information about the aspects of the technology which private corporations and/or organisations see to have the greatest commercial potential and/or global impact.

The concept of the blockchain has become quite popular in recent years, as evidenced in the number of Google searches conducted and executive surveys conducted by amongst others, JP Morgan, MIT and Deloitte and Touche (Shrier, Sharma, & Pentland, 2016). The Massachusetts Institute of Technology (MIT) conducted interviews with over 60 CEO's at the 2016 Davos forum and this led to the confirmation that *"Blockchain technology has entered the top strategic priorities of the CEOs of the Fortune 1000"* (Shrier, Sharma, & Pentland, 2016). MIT further noted that venture capital investment into blockchain applications rose to above $1 billion in 2015, representing 7% of total investment into fintech solutions (Shrier, Sharma, & Pentland, 2016). Whilst speculation is imprudent, MIT goes on to quote some industry sources about the potential global investment into blockchain rising to $10 billion (Shrier, Sharma, & Pentland, 2016). The tipping point for this flood of funding seemingly being the renewed interest of large banks and projects such as Singapore's "smart city" (Shrier, Sharma, & Pentland, 2016). This is seen to be similar to previous technology adoptions within the financial sector, i.e. there is slow development on the fringes of venture capitalism, and an explosion of growth when the larger venture capitalists and banking profit pools became involved (Shrier, Sharma, & Pentland, 2016).

In their white paper, specifically on Blockchain and financial services, Shrier et al (2016) describes the benefits of Blockchain as: (it) "…solves for trust, asymmetry of information and economics of small transaction without burdensome risk infrastructure and central intermediary". But perhaps most telling, is that whilst Shrier et al (2016) has high expectations for the blockchain, they do not regard it as the "silver bullet" solution to the issues of the financial sector. Rather, Shrier et al (2016) believe that blockchain is the innovation concept, and the true benefits will arise as the blockchain is combined with other technology components such as the Internet of Things to yield large-scale benefit to society. This is also similar to previous technology adoptions, a key example being the internet itself. Whilst designed for intra-company (army) communication, the internet expanded rapidly as other technologies developed to link into the internet (Shrier, Sharma, & Pentland, 2016).

Shrier et al (2016) describes it's concept of the "Five horizons of networked innovation", beginning with the first horizon as the development of the internet in 1970's and 80's. The second horizon is described as the creation of "intuitive navigation and cross-connection of information" with the rise of the World Wide Web. Thereafter, the third horizon of the paradigm is described as the concept of cloud computing and other networking innovations in 1999 and early 2000's. In the fourth horizon, the world experienced the launch of ubiquitous mobile devices and (early beginnings of) smart devices in the Internet of Things, combined with decreased bandwidth cost across the world. MIT references these four prior horizons as necessary preceding technologies which have led up to the fifth horizon – blockchain technology (Shrier, Sharma, & Pentland, 2016).

Shrier et al (2016) goes further to detail that at the very beginning of a technology horizon, the long-term winners (both in resultant technology and profit pools) are not visible – but shorter term futures are somewhat more clear. Given this view, it is most likely that early successes will arise in the segments of the nascent industries which attract the most funding (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016). Thus with the early stages of blockchain, given the spending in the banking and broader financial "fintech" sector, the earliest use-case successes – and first cases of blockchain-related disruption are most likely to occur in this segment of the economy (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016)

2.4.2. Major companies in the industry

2.4.2.1. The R3 consortium

Aside from Bitcoin, a good candidate for these early successes is the "R3 consortium". This consortium is a private company that is leading a group of 50 (and still growing) of the world's leading financial companies in the research and development of blockchain usage in the financial sector. The group aims to ***"collaborate with our partner institutions on research, experimentation, design and engineering. This propels the ultimate users of this new technology into the design and production process from the outset"*** (R3, 2016).

2.4.2.2. Ethereum

Further than R3's restricted-access blockchain/s, a blockchain-based platform company named **Ethereum** is aiming to bring blockchain applications to the mainstream audience (Pilkington, 2015). Ethereum has it's own cryptocurrency – Ether, which it uses to reward miners in the same way that Bitcoin does (Pilkington, 2015). However Ethereum's creator, Vitalik Buterin, is not focused on the cryptocurrency aspect, but is rather attempting to introduce blockchain applications by providing a

decentralised virtual machine that incorporates smart-contract functionality (discussed further below) (Pilkington, 2015).

2.4.2.2.1. Smart contracts

Simplistically, smart contracts are applications which are stored on a blockchain that can be used to determine verification or confirmation of particular requirements so as to prompt the execution of a basic contract (Heires, 2016).

These smart contracts are powered and cryptographically protected by every node in the blockchain (Heires, 2016). Peter Vaihansky, senior vice president at tech consulting firm DataArt describes a practical example of this as "an invoice that pays itself when a shipment reaches a port or a crop insurance contract that automatically pays out to a farmer based on information from a trusted weather data feed" (Heires, 2016). This of course requires blockchain to be increasingly linked to the Internet of Things, but also shows the simplicity of using contracts to disintermediate middlemen and existing market structures and thereby potentially speed up business activity (Heires, 2016). This links to the broader emerging themes of the Internet of Things, but perhaps more importantly – the Fourth Industrial revolution given the replacement of trust in a person, with trust in cryptography.

One major issue with listing a smart contract on the blockchain is that the parties engaged in a smart contract transaction are reliant on the coding of the smart contract being correct (Foroglou & Tsilidou, 2015). If there are flaws in the coding, these will be visible to all on the blockchain and potentially becomes exploitable. If downtime of the blockchain is required to change this code, consensus amongst the nodes (or at the least, a majority vote) would be required (Foroglou & Tsilidou, 2015). It would be difficult to get consensus from both parties in a two-party contract if the contract benefits one of the parties significantly. This point is important as smart contracts become increasingly used to act on legal contracts (Foroglou & Tsilidou, 2015). Laws would need to be adapted to cater for these potentialities in the future – or perhaps this could signal the rise of new forms of lobby groups (Heires, 2016).

Perhaps of a more significant point of information is that law is based on language, meaning that an interpretation of a law is required to be coded, potentially opening up the transaction parties to interpretation differences (as seen today in traditional contracting) (Heires, 2016). These factors matter as blockchain and other emerging technologies are rapidly making the financial sector a sector without borders or jurisdiction – and thus factors such as home country law or regulations come into play (Heires, 2016).

2.4.2.3. Bitpesa & remittance companies

Another example of how blockchain is increasingly merging economies is the use of blockchain currencies being used to transfer funds out of markets where currency regulations are strict and trust in central banks is weak (Shrier, Sharma, & Pentland, 2016). A leader in these cross border Bitcoin trades on the African continent is Bitpesa. Bitpesa has grown at an exponential rate in the past three years to become the leader in Bitcoin to central-bank currencies on the continent by linking the distributed ledger of the blockchain with the traditional foreign exchange market (Shrier, Sharma, & Pentland, 2016). Using Bitpesa and similar companies and platforms, companies from countries with hard currency restrictions such as Nigeria, Zimbabwe and Zambia are continuing to make purchases and sales with cross border clients – albeit at a lower level of trade (Shrier, Sharma, & Pentland, 2016).

In addition, many other developing countries with large diaspora populations across the world such as Bangladesh and Moldavia are experiencing an increase in the use of cryptocurrencies for cross-border remittance purposes (Shrier, Sharma, & Pentland, 2016). The two benefits of using Blockchain (via Bitcoin) for money remittances are basic, but powerful – 1) a lower cost for bringing in currency means more funds reach the diaspora's families, and 2) faster remittance allowing funds to reach families sooner (Shrier, Sharma, & Pentland, 2016). Shrier et al (2016) details its expectation that *"as this level of activity increases, regulatory authorities will undoubtedly take a more strict view on these activities"*. However Shrier et al (2016) goes further to conclude that is likely to be difficult for central banks and revenue services to control as *"governments that have attempted to restrict Twitter usage have found, once the genie is out of the bottle, it is difficult to recapture"* (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016).

2.4.2.4. Ripple labs

Aside from remittances, the true potential for blockchain may be the streamlining of the transfer of large-scale funds cross-border (WEF, 2015). Ripple laps, which uses blockchain technology in its Ripple platform, has become a key player in the payments revolution with an ambition to build a global payment protocol (Pilkington, 2015). In their 2015 report on the future of financial services, the WEF (2015) states that *"even in our technology-driven globalized world, it remains unrelentingly difficult to move money around the globe*". It goes further to describe its belief that a harmonized transfer protocol is needed to act at the interface between financial institutions worldwide (WEF, 2015). In the report, the WEF states that *"as an open* (and potentially universal) *protocol, Ripple enables a peer-to-peer server architecture to facilitate the movement of value among financial*

institutions. This allows financial services companies to make payments directly to each other, whether across different networks, geographic borders or currencies" (Pilkington, 2015).

By establishing a universal financial protocol, Ripple stands to unite financial institutions. Instead of each institution working within the confines of its own internal system regulations, Ripple's software serves to create a universal set of rules that each institution can utilise to speed up transactions with every other counterparty in the blockchain (Pilkington, 2015). In his report, Pilkington (2015) goes further to state that "the elaboration of a single protocol between the building blocks of the financial system is reminiscent of the invention of the Simple Mail Transfer Protocol (SMTP) in the early days of emails.

Pilkington (2015) describes the Ripple protocol as consisting of *"a real-time gross settlement system, the Ripple Transaction Protocol (RTXP), which secures instant and nearly free payments, currency exchange and remittance, regardless of size"*. Using this protocol, Ripple has created a hybrid of open and restricted access ledgers (Pilkington, 2015). It does this by allowing each participant the option to forego completely decentralised transaction approval (i.e. every node can participate) and instead select trusted validators from for example, only within your company (Pilkington, 2015).

2.5. The development of the blockchain technology in the banking industry

As mentioned previously, the "R3 consortium", is a private company that is leading 50+ of the world's leading financial companies in the research and development of blockchain usage in the financial sector. In July 2016, one of South Africa's largest banks – ABSA (an associate of Barclays PLC), joined the R3 network, the first to do so on the African continent (EconoTimes, 2016).

It is important to note how these institutions expect to achieve these cost efficiencies. In essence, these efficiencies can only be achieved if a majority of the trading partners are also on the same permissioned blockchain (MacDonald, Allen, & Potts, 2016). The simplest of these cost savings will be the reduction of fees to international clearing houses such as VISA et al. Similarly, elimination or at the least, alleviation of fees in the equity and debt instruments arenas is also expected to shake up what is currently a steady revenue pool for the global banks (MacDonald, Allen, & Potts, 2016). Of course, if one had to take the view that corporates will at some point establish blockchains within their companies, there are additional savings which are anticipated. The simplest of these being the reduction in efforts required to reconcile multiple ledgers, as well as the (assumed) reduction in auditing fees (Heires, 2016).

2.5.1. Blockchain's cost saving implications for banking

The question of whether a private blockchain within a company is necessary in the stead of a company-wide ledger is one which needs to be asked of the industry. This question balances the cost implications of such implementations (linking to legacy systems etc.) and the risk of being left behind if this is the way that the global banking industry goes (MacDonald, Allen, & Potts, 2016). Whilst there are wide ranges of estimates for the quantum of savings that could potentially be expected in the banking sector from both private and permissioned blockchains, Oliver Wyman (2016) has put forward an estimate of between ~$15-20bn saved within five years. Whilst the savings are significant, it is important to note that these savings come through increased efficiencies – and thus most likely will arise from job losses in the banking and associated sector (Oliver Wyman, 2016). This is a further contributor of the increasingly stronger fourth industrial revolution effect on automated processes replacing humans in the working world.

Nonetheless, through the gearing abilities of these financial companies, these savings can potentially generate multiples of these savings in new capital formation in the economy at current gearing multiples (Shrier, Sharma, & Pentland, 2016).

2.5.2. Blockchain's impact on lending via collateral registries

Aside from cost savings, blockchain is also expected to introduce new income streams given the anticipated disruption of current market processes and services. These new revenues are expected to combine with the cost savings to unlock further value creation in these sectors (Shrier, Sharma, & Pentland, 2016). But it is not only the new revenue streams that are expected to raise revenue in these businesses. Banks are also expecting an increase in interest revenue from its retail and commercial banking segments given the (slow) strides that blockchain is taking in the asset registration field (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016).

This is increasingly important to banks given the World Economic Forum's estimate that of over 200 million SME businesses across the world, as many as half cannot access funding to grow their businesses (Stein, 2015). The leading reason for this is cited as the lack of adequate and sufficient collateral, which limits the value of loans that an SME can source from the formal banking sector (Stein, 2015). Traditionally, immovable assets such as property are widely accepted as collateral. However, movable assets such as vehicles, plant and equipment, inventory and receivables are frequently not accepted – although they make up a significant portion of the SME balance sheet (Stein, 2015).

The key factor for these assets not being used in traditional lending transactions, is that there was little government funding and support for the creation of central collateral registries (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016). Given this, banks could place little reliance on the location and more importantly, the ownership of these movable assets, and thus significantly discounted these asset's value as collateral (Shrier, Sharma, & Pentland, Blockchain & Transactions, Markets and Marketplaces, 2016). Blockchain now provides an option for the creation of collateral registries outside of a central government function. In their paper on collateral registries, the IFC (2015) notes the significance of blockchain-based collateral registries on lending. Using data from countries which have had some reform in their asset registries, the IFC estimates that an 8% increase in loans to SME's is possible, with significantly lower lending rates – thereby potentially lowering the global financial sector's default rates (IFC, 2015).

2.5.3. Blockchain's impact on operational risk

One of the major risk types that banks keep equity/capital reserves for is that of operational risk (Damodaran, 2007). In South Africa, this operational risk capital is the second largest capital base (after credit risk capital). Two of the main sub-risk types within operational risk are that of process failure and internal fraud (Stradling, 2015). Given earlier discussions around the disintermediation of traditional middlemen, reconciliation and similar functions and the ability of blockchain to action transaction in a trustless environment, it is expected that the potential for operational break-down to lessen (Stradling, 2015). This will in theory allow a decrease in the amount of capital reserved for these break-downs, in a bank which uses Basel's Advanced Measurement Approach for the calculation of operational risk capital (Damodaran, 2007). In addition, reductions in settlement time between the bank and it's counterparties (e.g. hedge funds) can also reduce both the operational risk capital, and the counterparty credit risk in this trade (Stradling, 2015). Given that commercial (and merchant) banks typically price a client on a Return on Total Capital basis – i.e. including credit, operational and other capital types, this potentially can result in a further decrease in lending rates for clients (Damodaran, 2007). Little research has been conducted focusing specifically on the operational risk capital impact of blockchain, but given that blockchain is seen to simplify transactions, it potentially can have a significant impact on the global banking sector's operational risk capital base (Stein, 2015).

2.6. Conclusion of the literature review

The information outlined in the literature review examined some of the research that has been conducted in the field of blockchain. Given that Bitcoin is to date, the best and most wide-spread use-case of the technology, it is unsurprising to note that a large part of the research is attributed to the cryptocurrency aspect of the technology. Nonetheless, when insight specifically on blockchain

was provided in the literature review, it was evident that there are high expectations for the blockchain.

Whilst there seem to be many hurdles remaining towards adopting the new technology, the key hurdles seem to be human and organization attitudes, including a lack of standards and clear way-forward, high processing costs, and legacy infrastructure. In addition, resistance to the employment dislocation is a key factor which is expected to create inertia as the fourth industrial revolution begins to take hold in the global economy.

The literature review revealed that the technology is not without its weaknesses, and critics, but overall the banking community is keen to work together to tap into the potential for blockchain to cut costs and open up new revenue streams in the future.

The fact that major banking players are joining the blockchain is a particularly interesting turn of events, given that the first blockchain application, Bitcoin, emerged due to the diminished trust in the financial sector. A further point of interest is that these financial players seem to be targeted at boosting efficiencies, rather than overhauling an industry – as Satoshi Nakamoto intended when he (they) launched Bitcoin.

2.5.1. Research question

- What are the factors about blockchain that banks are interested in?
- What do banks feel are the current restraints to blockchain implementation in the industry?

RESEARCH METHODOLOGY

3.1. Introduction

The third chapter of this report details the methodology that was used to address the research questions that have come forward in the previous literature review section. Given the rising expectations about the impact that blockchain technology can have on society, the researcher believes that this research can play a significant role in the understanding of how the South African banking sector views this technology and how they see this technology improving the banking segment. The literature with regards to the requirements of research methodology will be discussed, followed thereafter by a description of the research design before going into detail about the research instrument to be used, including the data collection procedure and other related aspects of research.

3.2. Research methodology /paradigm

Bryman (2012) stated that there are three types of research paradigms. These are: quantitative, qualitative and mixed-methods research. He goes further to state that it is important to select the appropriate paradigm for the research problem that one is seeking to address.

The researcher opted to conduct a qualitative research paradigm for this study. Given the relatively short period of time that blockchain has been in existence (in this particular format), much of the information and prior research reviewed in the previous chapter was on a qualitative basis. This is possibly due to the fact that it is only in 2016 that measureable business cases are beginning to result in meaningful and measurable metrics. Qualitative data is defined as “all non-numeric data or data that has been quantified” (Saunders, Lewis, & Thornhill, 2009). They go on to describe qualitative research as the collation of this data via methods such as “short list of responses to open-ended questions, online questionnaires or in-depth interviews”.

According to Saunders et al. (2009), qualitative data analysis assists in analysing this data, and thereby allowing one to develop a theory from your data. Given the complexity of gathering and interpreting the potentially wide-ranging thoughts of multiple different stakeholders, Saunders et al. (2009) also suggests a qualitative research approach. The researcher’s choice of qualitative research was also supported by the work of de Ruyter & Scholl (1998), in which they state that “qualitative research often has a diagnostic and exploratory nature”. They go further to state that the process of analysis and meaningful integration of the views expressed by participants can provide significant meaningful insight.

Finally, some additional important reasons that the qualitative research method was used are that:

- The researcher needs to explore a future state of the banking sector with blockchain,
- Given the novelty of blockchain, and the relatively low number of subject matter experts in the industry, the sample size is small.
- In-depth semi-structured interviews can be used with a group with varying knowledge levels

Qualitative research is thus the most appropriate research paradigm for this particular study.

3.3. Research Design

Given the aspects discussed in prior sections of this chapter, it is felt that semi-structured interviews with participants would be the optimal method to gather data. Saunders et al. (2009) describe semi-structured interviews as *"non-standardised questioning, in which the researcher will have a list of themes and questions to be covered, although these will vary from interview to interview"*. The researcher believes that this will be the most optimal method given that the research is on a relatively new technology and that there is likely to be widely ranging opinions across the sample set. The semi-structured interview approach will also suit this type of sample set as it allows order of questions to vary depending on the flow of the conversation, or to pose and explore additional pertinent questions if they present themselves in the interview.

Given the nature of this research, the research is a cross-sectional study in which data is collated via the semi-structured interviews (Saunders, Lewis, & Thornhill, 2009). The research is considered cross-sectional given that the researcher's intention is to understand the industry's opinions at this point in time, rather than the evolution of opinions over a period of time (Saunders, Lewis, & Thornhill, 2009). It is intended that this research will be conducted on a "one-on-one" basis, with the default approach being a face-to-face interview.

This type of semi-structured interview approach does have some disadvantages, which the researcher is cognisant to avoid. The key disadvantage of this is the possibility of bias being drawn into the process. Saunders et al. (2009) discusses the two most common biases as:

1. **Interviewer bias**
    a. Where the interviewer's tone, comments and non-verbal behaviour creates a bias to the manner that the interviewees respond
    b. In addition, there could interviewer bias in the manner in which data is interpreted by the interviewer

2. **Interviewee or response bias**
    a. Caused by the perceptions about the interviewer
    b. Caused by sensitivity to sharing information on certain aspects of the topic

These and other factors such as subjectivity of the interviewees can result in a study that is difficult to replicate (Saunders, Lewis, & Thornhill, 2009). Finally, the specific sample selection – especially in a relatively small pool of subject matter experts such as the blockchain environment, makes the results difficult or impossible to extrapolate to a larger population (Leedy & Ormrod, 2010). In a bid to decrease the possibility of these disadvantages, triangulation was sought by studying the bodies of knowledge available on blockchain, cryptocurrencies, the cross-border flow of funds and the payments process of a banking sector so as to ensure that the researcher correctly interprets the data from the interviews (Saunders, Lewis, & Thornhill, 2009).

3.4. Population and sample

3.4.1. Population

Saunders et al. (2009) describes a population as the full set of cases from which a sample is taken. The target population of this research were the participants in the commercial and merchant banking segment of the South African banking market. This includes the banking staff, regulators, intermediaries and software developers servicing the industry.

3.4.2. Sample and sampling method

Bryman (2012) defines a sample as a subset or portion of a population, which is selected for research. Given the large number of individuals in the chosen population, it is impractical to expect to obtain feedback from the entire population for many reasons including restrictions on time, money and access to individuals (Bryman, 2012). The sampling techniques that can be used are spilt into two categories – probability (or representative) sampling, and non-probability (or judgemental) sampling (Saunders, Lewis, & Thornhill, 2009). Non-probability sampling is appropriate to be used in scenarios in which one can select samples based on the researcher's subjective judgement.

Non-probability sampling is further broken into four techniques: snowball sampling, convenience sampling, purposive sampling and quota sampling (Saunders, Lewis, & Thornhill, 2009). Whilst a quota sampling technique would be the most beneficial in that it attempts to reach a close representation of the total population mix (Bryman, 2012), the researcher chose a combination of the purposive sampling technique, in which individuals were selected according to their ability to enable the researcher to answer the research question and the snowball technique. This was seen to be a meaningful method of finding and sourcing data from contributors given that individuals in the

population set chosen by the researcher can be difficult to immediately reach without reaching out to mutual associations (such as with employees of the South African Reserve Bank).

It is acknowledged that the purposive sampling technique potentially introduces bias towards a single or limited segment of one's target population (Saunders, Lewis, & Thornhill, 2009). However given that the blockchain is relatively new concept, the number of experts in the field is low and thus active selection is deemed the best method to attaining the information required to answer the research question (Saunders, Lewis, & Thornhill, 2009).

In addition, the snowball technique was also incorporated given the relatively nuanced field of study that blockchain is today. Whilst there are a growing number of developers etc. working on blockchain solutions, many of these were or are working on more traditional applications as well – and to date, very few formal blockchain forums have been formed to share ideas in South Africa. Thus the snowball sampling technique was beneficial in linking a known blockchain developer/person with blockchain knowledge with others that are experienced in the same field (Saunders, Lewis, & Thornhill, 2009).

The aim of this research is to get the opinions of industry participants who have knowledge of the blockchain and applications thereof in the commercial lending and merchant banking segments. The sample was thus selected from:

- The four largest commercial banks in South Africa (FirstRand, Nedbank, Barclays (through ABSA) and Standard Bank)
- The technology consulting houses in South Africa which advise the banks on technology trends and implementations (Deloitte, PWC, True North consulting)
- Individuals within the South African Reserve Bank
- Individuals within the financial systems intermediaries (SWIFT, STRATE)
- Software solution developers (Dariel Software, Dimension Data)

Initially, a target sample size of at least 12 respondents was set. The aim was to have at least 8 interviews with the banks and at least one interview with the remaining four groups. The snowball technique proved to be useful in sourcing additional individuals with knowledge form this initial sample group. The relatively small sample size is seen to appropriate given the novelty of the technology in South African banking.

3.5. The research instrument

As discussed previously, given the need for the researcher to understand the reasons for the respondent's opinions, the semi-structured interview was chosen as the research technique for this study. The interview instrument that was used to collect the data was an interview schedule. The schedule included a series of questions that was aimed at probing the meaning and causality of the respondent's responses (Saunders, Lewis, & Thornhill, 2009). The interviews were conducted face-to-face, and on a one-on-one basis. These proved to best enable the researcher to establish rapport and most effectively used the time allotted (Leedy & Ormrod, 2010).

Given the type of topic being researched, the questions chosen were designed to focus the respondent's thoughts on a relatively narrow field – commercial and merchant banking. Whilst the interview was not expected to exceed 60 minutes, it was found that some interviewees required some additional time in the interview to consider thoughts on topics that had not been considered previously. In addition, the researcher used additional time to probe deeper on specific responses where relevant. The research schedule and covering letter that was sent to all respondents motivating them to participate is included as Appendix A in this report.

3.6. Procedure for data collection

The researcher leveraged the relationships and networks that he has through the fintech incubator – "the Foundery" within Rand Merchant Bank. In addition, the researcher also made independent connections with peers with blockchain development experience during the research stage of this project at various conferences and forums.

The first step was the setting up of interview appointments ahead of the intended meetings so as to establish the commitment of the respondent (Saunders, Lewis, & Thornhill, 2009). Where possible, the researcher scheduled the interviews at a neutral location so as to diminish social and cognitive biases in the interview. It was noted that given the use of the purposive sampling technique (and thus a selection of senior individuals in the industry), there were respondents that requested the convenience of their offices. Follow-up phone calls and/or face-to-face discussions were had to persuade those interviewees who did not respond to initial emails.

The second step commenced with the interviewer sending an electronic, summarised version of the research proposal to the interviewee, together with the interviewee consent form (Appendix B). The researcher sent a copy of the broad themes of the interview schedule at least two days prior to the interview, to enable a more effective interview as suggested by Saunders et al (2009).

At the beginning of the interviews, the interviewees were asked to sign the consent form previously sent to them. Permission was sought for the audio recording of the interview, so as to allow the researcher to give the maximum amount of attention in the interview itself. These were transcribed by the researcher after the interview. The researcher took pertinent notes in the interview however, so as to capture non-verbal and other considerations found during the interview (Saunders, Lewis, & Thornhill, 2009).

As considered best practice (Bryman, 2012), no participant names were stored. Instead, identifier codes were used on all data files and the list of participant names and their associated codes were stored separately.

3.7. Data analysis and interpretation

The analysis and interpretation of data provides an understanding of the message within, and how it relates to the research question. Whilst there are numerous methodologies one can use to analyse the data, Leedy & Ormrod (2010), are not adamant about there being a single "right" way of analysing qualitative data. They go further to say that it is the subjective opinion of the researcher who begins with the complete data pool, and then gradually cuts it down to small sets of underlying themes (Leedy & Ormrod, 2010).

As suggested by Bryman (2012), the following steps were used when analysing qualitative data.

Step 1: Processing of raw data in the form of the audio recording. The audio recording was reviewed for any obvious flaws in feedback prior to the transcription of the data. This involved the listening to the audio record and reading the notes made during the interview (Bryman, 2012).

Step 2: The transcribing of the data. This involved a focused listening of the recording with the intent of typing the interviewees messages obtained from the interview. The transcripts were read several times to ensure that the information being transcribed was logical and true to the discussion with the interviewee. Thereafter, the transcripts and field notes were coded and attached to the interpretative memos (Bryman, 2012).

Step 3: The overall data was then reduced to meaningful segments or themes which were developed during the literary review stage. If possible and conducive to purpose, sub-segments and themes were introduced at this stage (Bryman, 2012).

Step 4: The data was then assessed to pick up any patterns and relationships between the segments and themes (Bryman, 2012).

Step 5: The data was then interpreted and summarised into data tables and/or charts that assisted in extracting core learnings from the information (Bryman, 2012).

3.8. Limitations of the study

The semi-structured interview technique used does have disadvantages such as interviewer and interviewee biases (Saunders, Lewis, & Thornhill, 2009). In addition, given the non-probability sampling technique used, the results cannot be reliably generalised to the rest of the population (discussed further in section 3.9.2 below) (Saunders, Lewis, & Thornhill, 2009).

A further limitation is that at this stage, all the proposed interviewees were based in the Gauteng province due to time and cost constraints. Whilst potentially problematic in terms of diversity of interviewees, this was considered inevitable given that the headquarters of the four largest banks are based in Johannesburg. There is potentially a missing portion of knowledge in this geographic concentration given that a large amount of software research and development takes place in hubs in Durban and Cape Town.

An additional limitation to the research is that there was a disproportionate mix of interviewees in the five categories mentioned previously in section 3.4.2 above. This could potentially have an impact on the depth of knowledge dispersed in the interview process.

3.9. Validity and reliability

Given the qualitative, and more specifically the semi-structured interview approach taken in this research, the researcher needed to be cognisant of the validity and reliability aspects of the research. Saunders et al. (2009) describes validity as being concerned with whether findings are actually about what the researcher interprets them to be about. There are two broad aspects to validity, these being internal and external validity (Saunders, Lewis, & Thornhill, 2009).

3.9.1. Internal validity

Saunders et al. (2009) states that the researcher can gain internal validity with reference to interviews if he "gains access to the interviewee's knowledge, and is able to infer a meaning that interviewee intended". To ensure the internal validity of the research, the researcher presented the write-up and conclusions to the participant, and any feedback or correction were taken into account. In addition, the triangulation discussed previously benefited the understanding of the interviewee's opinions and knowledge.

Saunders et al. (2009) does elaborate further that internal validity is a lesser concern in a semi-structured (and unstructured) interview given the researcher's ability to probe deeper and explore

meaning within the research instrument itself - relative to questionnaires and other qualitative methods.

3.9.2. External validity

Saunders et al. (2009) states that the researcher can gain external validity if he is able to generalise the results to context outside of the sample set. As discussed previously, given the specific sample selection of subject matter experts in the blockchain environment, there would be high levels of difficulty in applying these results to a larger population. This is particularly true given the vastly varying levels of research being conducted in the different parts of the banking sector (Leedy & Ormrod, 2010). Bryman (2012) has warned that many research projects which restrict the sample set to one country should not be generalised to a more global view. However, given that the researcher intended to ascertain the opinions of the South African banking sector in particular, this was not expected to be a major concern for the external validity of the research. Thus it is expected that the results could not be generalised to the broader South Africa – and importantly, it is not a shortcoming of the research to not have generalizable results.

3.9.3. Reliability

Given the nature of the semi-structured interview, there is (as previously discussed) almost a certainty that the results will not be repeatable. Saunders et al. (2009) however provide strong rationale that this is not only expected, but should be an accepted aspect of conducted research in this manner. They state that when using non-standardised interviewing techniques, “the responses reflect reality at the point in time that they were collected, in a situation which may be subject to change” They go further to emphasise that the value of this method of research is derived from “the flexibility that one may use to explore the complexity of an issue” – and thus it is unrealistic to expect results which can be completely replicated without sacrificing the strength of this research type (Saunders, Lewis, & Thornhill, 2009).

Nonetheless, efforts were made to make and retain notes relating to the researchers design, the reasons underpinning methodology choices, and the (anonymised) data therein. This is intended to allow future researchers to understand the processes used and enable to recreate the research methodology and parameters at another point in the future so as to allow multi-period result analysis as blockchain develops in the industry.

4. PRESENTATION OF RESULTS

4.1. Introduction

This main purpose of this chapter was to present and describe the findings from the semi-structured interviews conducted with the group of interviewees from within the South African banking sector. Where possible, the responses were presented in either a tabular or chart format for ease of transference of information. In some portions of the chapter, respondents were quoted as the researcher felt that this would more appropriately convey the opinions of the respondents, and thereby provide additional insight.

The questions in the interview schedule were structured so as to promote thought around the two research questions that the researcher presented in chapter 2. The presentation of results in this chapter is thus structured to examine the factors which are prompting the South African banks to research blockchain solutions. Thereafter, the factors which are felt to constrain the development of mainstream blockchain solutions in the banking industry are presented and briefly described.

Both sets of responses are discussed and explained in further detail in chapter five of this report, and will be analysed with reference to the literature review found in chapter 2 of this report.

It should be noted that this research was conducted in August 2016, and thus represents the opinions of the South African banking sector as at this date. Given the research being conducted in this still-novel technology, there are expected to be opinions and challenges which would differ to the time of reading.

4.2. Profile of respondents

Given the intention of the researcher to limit the research to *South African* banking executives, the respondents comprised of representatives from the four largest banks in South Africa. The bank respondents were selected on a basis of providing a representative spread of a bank's business structure. Thus, the banking respondent pool includes: 2 Retail banking representatives; 3 Corporate and Investment Banking representatives and 4 executives from a Treasury or holding company perspective.

In addition, one respondent was from a consulting company which was conducting work on a blockchain proof of concept within a Big four bank. Finally, given that the key aim of blockchain technology was to disrupt the current (trusted intermediary) structure of the market, the researcher felt that it was important to interview one of the key intermediaries to the banking system. The researcher thus interviewed an executive of South Africa's Central Securities Depository - STRATE to understand the impact of blockchain on it's business lines. All respondents have strong banking

backgrounds, with most having broader financial market experience. All respondents had knowledge of and/or experience in blockchain technology development within their respective banks.

4.3. Factors driving South Africa's banks to develop blockchain solutions

The presentation of results begins with a review of the factors which the respondent group felt would drive the banking sector towards developing an increased number and scale of blockchain solutions.

As introduced in chapter 2, the researcher felt that it critical to understand a) the specific aspects of the blockchain technology, and b) the perceived benefits from blockchain technology that the South African banks are expecting to utilise and experience in their respective businesses. This was seen as a critical part of the research as it would provide some context to new developers and/or interested service providers as to the aspects of blockchain technology that the banking sector is interested in. Focus was thus given to this aspect so as to enable developers to meet industry expectations, and thereby grow blockchain usage in the country's banking, and broader financial sector.

The respondents provided a variety of responses to the questions aligned to research question 1: "**What are the factors about blockchain that banks are interested in?"** However it is interesting that many of the group's responses were similar and included a core group of benefits. These responses, where possible, have been graphically represented in the exhibits within section 4.3. below. It was also interesting – but not unexpected to note that the more nuanced responses came from those individuals who are working directly on blockchain-related development. In summary, the factors most cited are blockchain's ability to: a) increase efficiency, b) reduce transaction time and c) the dis-intermediation of intermediaries (traditional banking intermediaries included) – and the associated reduction in costs.

4.3.1. Extent of blockchain development conducted to date

The South African banking industry has been traditionally described as four major banks (Nedbank, Standard Bank, ABSA/Barclays and FirstRand (FNB & RMB)), and more recently, has also included Investec and Capitec in the Tier 1 bank lists. Whilst the country has over eighteen banks in the country, an additional fourteen international bank branches and numerous international bank representative offices are also represented in South Africa. However, the majority of the country's banking assets and liabilities are concentrated in the four major banks listed above.

Given the scale of these banks, it is interesting to note that whilst six of the eleven respondents state that their organisations began their informal involvement with blockchain more than 24 months ago, seven of the eleven respondents began their formal programs only in the last 12 months. There

were two respondents who listed project start dates as recent as March 2016 (6 months prior to the time of writing). The three respondents which stated that their formal program had begun 12-18 months were all part of the same bank, and cite strong management support as a key reason for their ability to commence earlier than the rest of industry. Nearly all of the respondents listed Bitcoin as the focal point of their informal involvement. Informal involvement was described as reading and discussion of available literature.

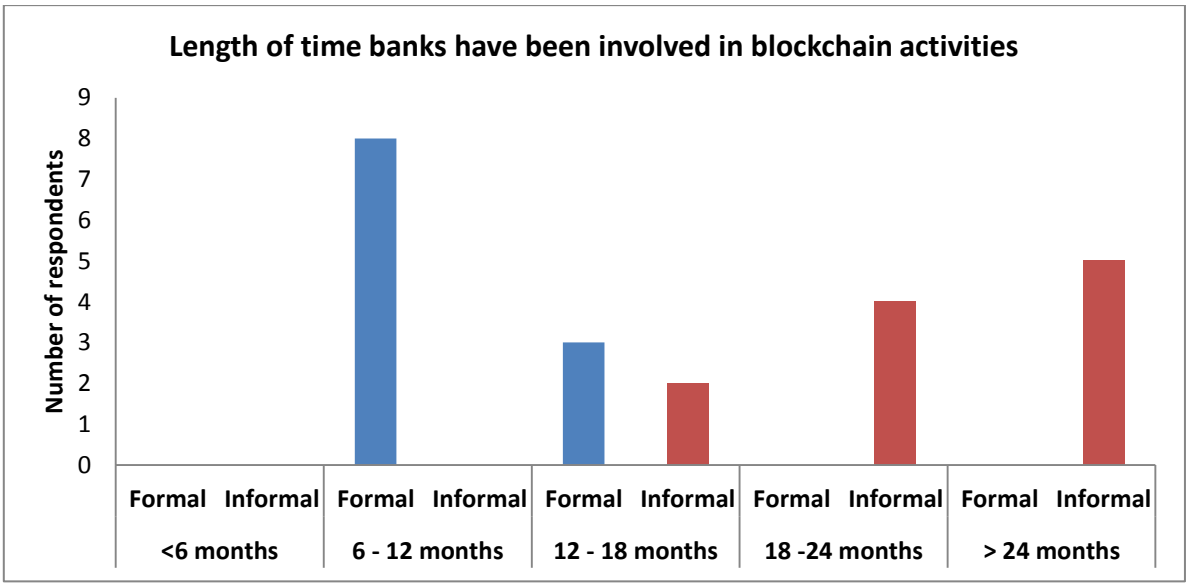

Exhibit 1: Length of time that South African banks have been conducting blockchain project

4.3.2. Reasons driving blockchain research in South African banks

As can be seen in exhibit 2 below, there are four primary reasons that were represented in all the respondent's answers to the question 1b: *What are the factors that have led your business to look at blockchain solutions?* These were: a) to understand and respond to the threat of intermediation; b) to reduce costs of payments, clearing and settlements; c) to reduce the transaction time of trades etc. and d) to gain efficiency in clearing and settlement processes. It is logical that factors ***b, c*** & ***d*** above would be the key underpinnings of the industry's venture into the blockchain given that there are arguably similar offerings between all four banks in a very mature banking sector. Thus there is a need to offer decreases in costs; increases in speed or enhanced value-add in each banks offering to their respective client bases.

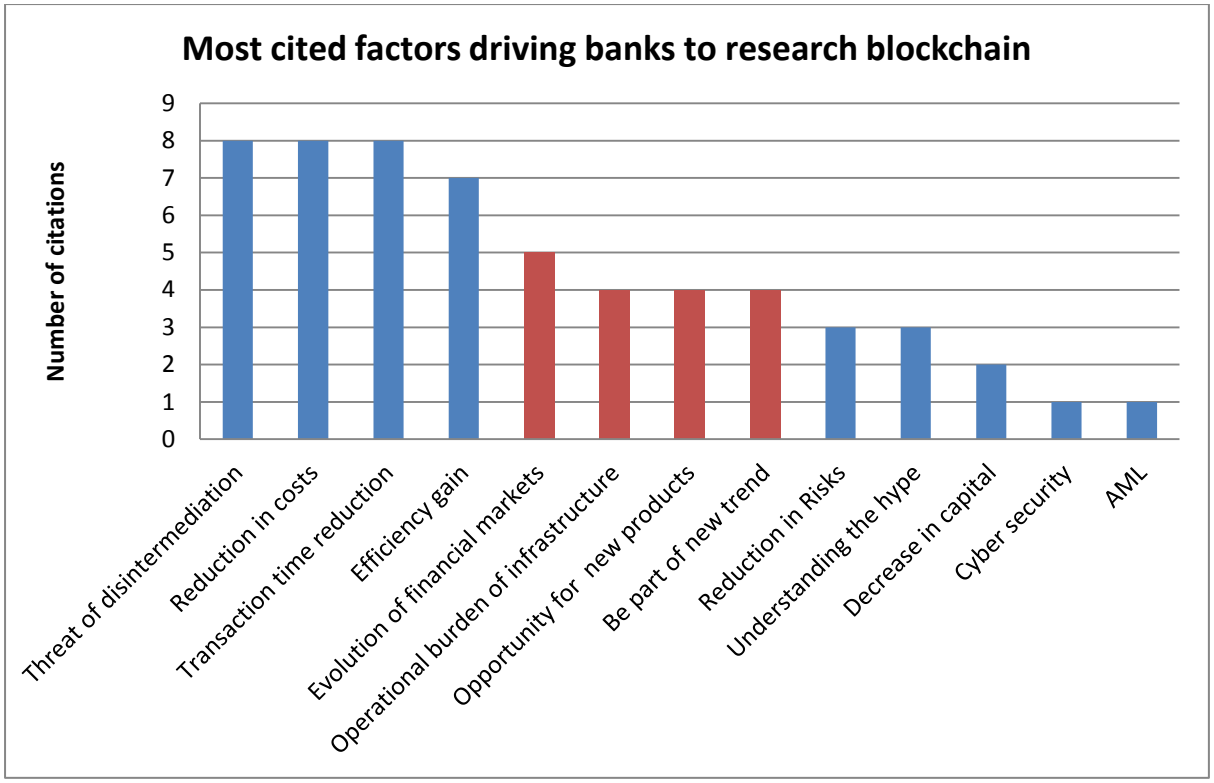

Exhibit 2: Factors prompting South African banks to research blockchain

In addition, given that banks are one of the intermediaries which Bitcoin sought to circumvent, and the increasing journalism about the blockchain's disruption of the banking value-chain, it is again logical that the banks would list the "understanding and responding to the threat of intermediation" as one of its key reasons for research and development in the field. A respondent provided detail on this aspect as follows:

> *"The aim is to make our clients lives better by making transactional banking easier, faster and more efficient. Any cost reduction/time saving that we can make by eliminating any non-value-adding component of banking will be beneficial to the client as the savings are passed on to the client pricing. If we don't disrupt ourselves, other non-banks and banks will, (in order) to serve our clients"*

In addition to these four primary factors, there were four secondary factors which presented themselves fairly often in the research. These are represented as the maroon bars in exhibit 2 above. These secondary factors were: e) to evolve the financial market, f) to alleviate the operational burden of the existing payments and settlements infrastructure, g) the opportunity to launch new products and/or services and h) to be a part of a new trend in the industry.

Factors ***e*** and ***f*** were reasonably linked to the primary factors, and spoke to a "blue skies" vision of how the respondents would see the industry and the detailed constraints in the current payment

channels of the industry respectively. Finally, the interest in using blockchain to develop new products (factor ***g***) is also understandable given that revenue generation, or the monetizing of a technology, is a natural part of the growth of any new technology development. Both these aspects will be discussed further in chapter 5.

4.3.3. Targeted business line introduction

The respondents were also asked which of their respective banks business segments were being tested for blockchain application developments. The responses can be seen in exhibit 3 below.

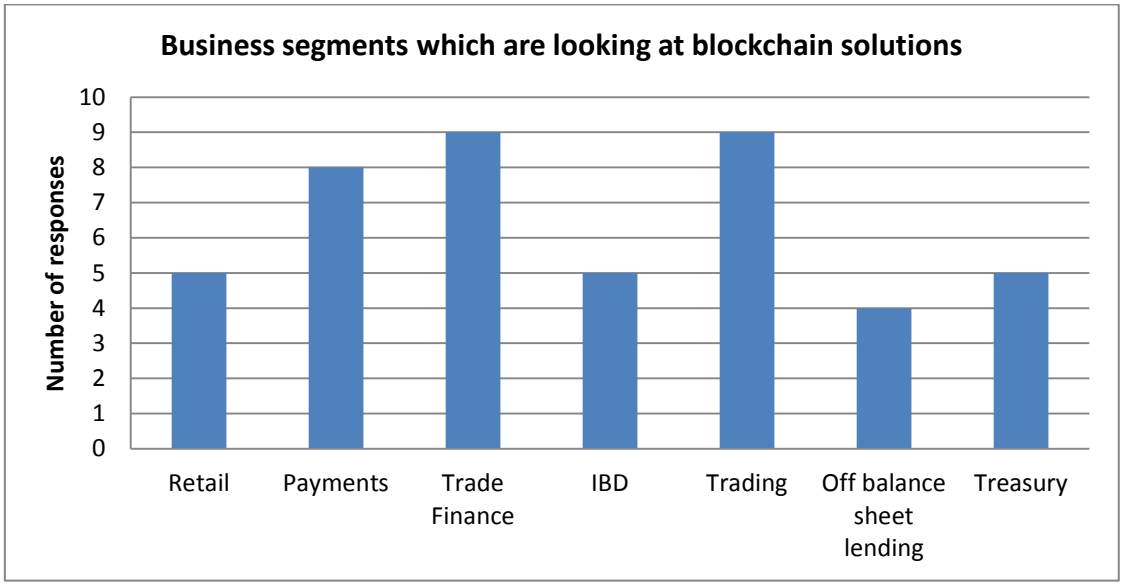

Exhibit 3: Analysis of business segment interest for blockchain solutions

The respondents predominantly identified potential use-cases for blockchain solutions in the a) payments, b) trade finance lending and c) trading businesses. These businesses have a close association with the expected benefits described in section 4.2.2 above. Thus, it is natural to expect that these businesses, which all utilise one or all of the payments, settlement and clearing aspects of the existing market infrastructure would be seeking optimization of costs and processes. The treasury and IBD solutions were also closely linked to the trading and central-bank clearing aspects of the banks businesses and thus would benefit for the same reasons. It was interesting to note that across the banks, the respondents from retail-banking segments only expressed interest from a foreign-exchange (sales and remittances) perspective, with two respondents discussing Bitcoin as just another currency with which their respective banks clients wished to trade.

Within these business segments, the blockchain activities being conducted vary according to the focus of the bank, the segment-type or the availability of resources within the business. The key

activities being conducted amongst the respondent's respective banks can be seen in exhibit 4 below.

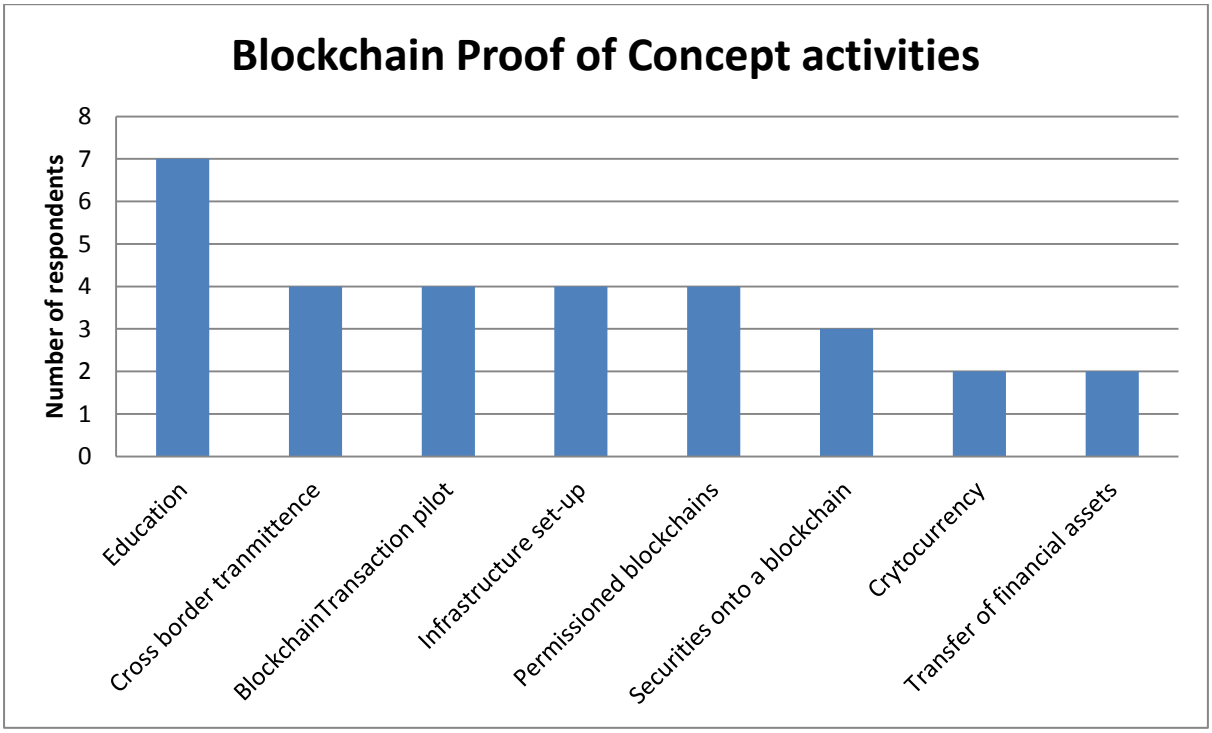

Exhibit 4: Blockchain activity types within South African banks

It is important to note that the most common activity being conducted by the banks thus far is the educating of businesses and the bank as a whole about the potential uses of, and benefit from the blockchain.

This also speaks to the varying levels of maturity and knowledge-sets amongst the banks, with some of the respondents seeming to have attained sufficient traction within their respective banks to proceed with projects past the proof of concept stage. Amongst the respondent's banks, the development teams have been conducting projects in the a) cross border remittance, b) a blockchain transaction pilot, c) the initial set-up of infrastructure for future blockchain trials and d) private or permissioned blockchains for use within a single company or industry. There were 3 respondents which were interested in the issuing of new financial assets directly onto a private blockchain, and only 2 respondents who were currently working on cryptocurrency launches or integrations. Finally, it is noteworthy that none of the respondents listed a project focusing on replacing existing ledgers as a priority blockchain project, although this use was mentioned in more than one interview.

Within the blockchain transaction pilots, and as described previously, there is a significant degree of expectation that the use of the blockchain *on a country-wide scale*, could unlock increased collateral for borrowers to use in obtaining loans from the banking sector. This was expected to emerge if

blockchain-based asset registries (for houses) became a reality on the African continent. Of the ten respondents who answered the question about whether blockchain could increase lending, seven believed that there could be substantial increases in lending volumes and the borrowing ability of clients in countries which *currently* did not have strong asset registries. The reasons for this belief will be described further in chapter 5.

All but two respondents believed that blockchain would have a significant impact on banking globally, albeit in the long term. The two divergent views echoed the remaining respondents' views on the long term roll-out of blockchain, but instead believed that other technologic and social advances would be able to gain traction quicker and more effectively than the blockchain.

Whilst the ten respondents all believe that the blockchain will significantly impact the industry, all had pre-requisites for this to take place. These prerequisites, in summary, referred to government will to change current processes, and will be discussed in chapter 5.

Nonetheless, whilst all ten respondents believed that there would be negative impacts on existing revenue lines of their businesses, there was a majority which was confident that their banks would be able to leverage the blockchain to create new, or strengthen existing product offerings. The majority of the respondents believed that the decrease in revenue would be due to two parts of the business: a) decreased trade volumes in the retail and commercial foreign exchange businesses and b) the decreased transactional fees that the banks currently receive for transactions. These new products would thereby offset at least some of the reduction in revenue – which would be in addition to the expected cost benefits in the long run.

4.3.4. Capital implications for banks

Given the importance of capital to the banking sector as a whole (due to regulatory pressure etc.), the researcher felt it pertinent to question whether the respondents and their banks saw any potential capital implications from an introduction of the blockchain within the industry, and broader economy. The respondents were asked to answer this question from both a profit generation, and a risk weight asset (RWA) point of view given the importance of both of these in determining the capital adequacy of a bank by the banking regulator.

Given the respondents view that revenue would be impacted by a large-scale implementation of the blockchain into the financial sector, the respondents thus saw the corresponding impact as an initial reduction in profit *growth,* prior to new blockchain-related product/services related revenue becoming available. Any reduced growth in profitability would impact the banks' ability to grow its balance sheet and therein further inhibit future profit growth.

A critical point which came across quite strongly from the respondents is that there is an expectation of balance sheet reduction, leading from reduced deposits. This expectation of deposit reduction arises from two sources: a) increased cash being converted and held in cryptocurrencies and b) increased placement of household savings into assets not currently available to the retail saver. These are assets which are currently considered illiquid, such as bonds, institutional debt issuances and other such financial assets. Both of these expectations will be discussed further in chapter 5.

From an RWA perspective, the group's responses predominantly spoke to three types of risk: 1) credit, 2) counterparty credit and 3) operational risks. Six of the ten respondents who answered the question expected some credit RWA reduction arising from the increased collateralization of their banks respective client bases and the more efficient transfer of ownership of assets between counterparties (thereby decreasing loss given default (LGD) metrics of an asset). The respondents who were positive on this question again emphasised that their expectation would only materialise if the broader market and country took up blockchain solutions in asset registries and other such public sector functions.

Eight of nine respondents expected a reduction in counterparty credit risk in their banks trading and related businesses, arising from reduced "friction" in the settlement process. This, given the shorter time exposure of the bank to the counterparty, would result in reduced settlement times and correspondingly, a reduced counterparty credit risk. The two respondents who did not answer on counterparty credit risk were from the retail banking segments of a bank, and thus are not exposed to this specific risk type.

All ten banking respondents provided feedback on the impact on operational RWA. It is interesting to note that none of the respondents explicitly stated that they expected a reduction in operational RWA. Instead, there was acknowledgement that whilst the blockchain could lessen the probability of certain operational risk events, there would undoubtedly be new operational risks events which would in time, come forward.

Five respondents specifically mentioned that there is likely to be a reduction in fraud risk events for activities which are migrated to the blockchain, however two respondents was adamant that fraud risk could increase. The increase in fraud risk was cited to be a factor of increased transactions by and between devices (in conjunction with the Internet of Things). The respondents emphasised the relatively low levels of skills in fraud risk management teams today in tracing these types of (blockchain) transactions if participating members are allowed to be anonymous. One of these

respondents described the indirect impact of increased fraud events on operational losses/expenditure as follows:

> *"Increased fraud events are expected, but it is blockchain's speed of settlement and the associated immutability of the transactions which will have an impact on the business's expenses. Today, there is potential to reverse a transaction, with the bank claiming back from an insurer for those losses which are unrecoverable. If increased transactions take place using a cryptocurrency, then there could larger volumes of transactions that are immutable and irrecoverable – thus increasing insurance costs, or at the worst case, resulting in the insurance companies being reluctant to insure the banks fraud. In time, this fraud could potentially become the clients cost and risk".*

One of the respondents captured another important point about the "rotational" characteristic of operational risk, and is represented below:

> *"Operational risk could increase or decrease – or merely shift between the types of operational risk. Currently, process breakdown, system failure and fraud are the areas of operational risk which require the highest capital holdings. With Blockchain, there could be reductions in process breakdowns in for example, reconciliations, but this could be replaced with an increased system failure risk – given that additional control is being given to a non-human process. Blockchain itself is not riskless; it may just have a risk profile that we have not considered as yet".*

Finally, another respondent made the comment that:

> *"…simply because a blockchain* or any new technology *may be safer in some regard, this does not necessarily imply a reduced operational risk capital holding. Currently, in order to prevent banks from arbitraging capital calculations, there is an operational risk capital floor* (instituted by the SARB)*, below which the bank cannot reduce its operational capital holdings".*

Thus the respondent made the point that blockchain should first and foremost be seen and utilised as a utility with which to ease the banking and transacting experience of our clients, with any reduction in operational risk being an added bonus.

4.4. Constraints to blockchain implementation in the industry

Given the need to understand the banking sectors intention and ability to implement blockchain solutions in the industry, the researcher considered it pertinent to understand the current development capability of the banking sector, as well as the impediments to large-scale implementation according to the research group. This was accomplished via four questions in the research schedule, which referred to three aspects: skills analysis, resource analysis and a comparison as to how the respondent banks felt the South African industry compared to the rest of the world.

These questions were used to address the second research question of: **What do banks feel are the current restraints to blockchain implementation in the industry?**

4.4.1. Reasons for slow blockchain development in the South African industry

When asked which immediate and long term changes were required to develop mainstream blockchain usage in the industry, the most common responses were as represented in exhibit 5 below.

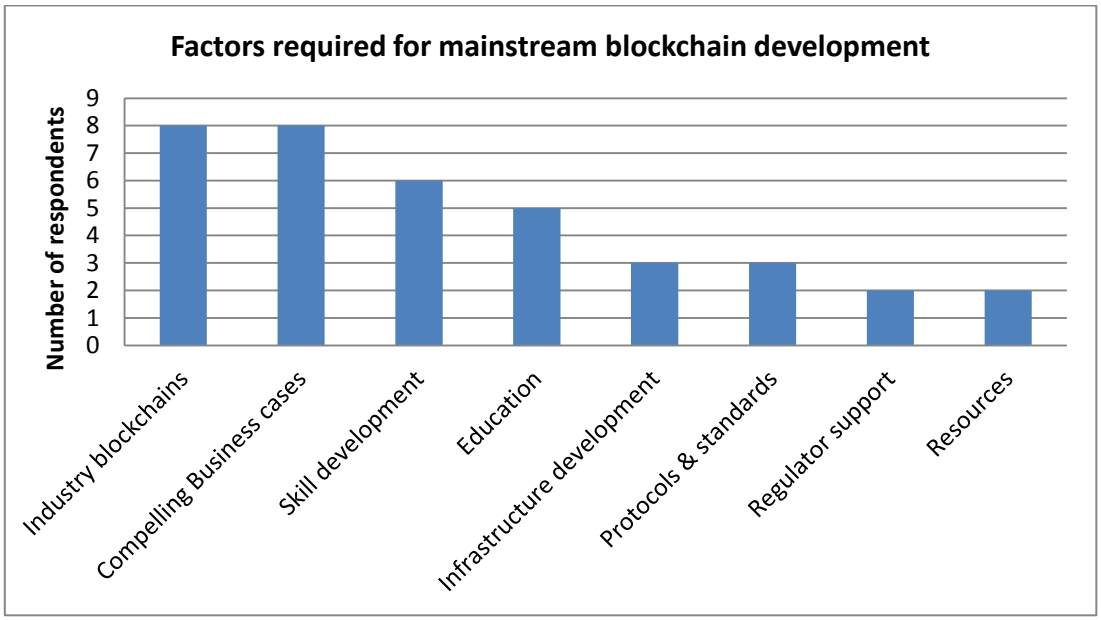

Exhibit 5: Factors required to develop further blockchain usage

4.4.1.1. Industry blockchains and protocols & standards

In addition to the need for increased amounts of strong business cases, the need for industry-wide blockchains was listed by seven respondents. This was cited because most of the respondents felt that for the blockchains true benefit to be experienced, it would require the ability of multi-counterparty trade on a blockchain – i.e. an industry-wide platform. This concept is discussed further in chapter 5. This requirement for industry-wide blockchains could also be combined with the three

responses for the need of additional blockchain infrastructure development so as to achieve the blockchain platform.

In addition to these blockchain platform requirements, three of more technically inclined respondents listed the need for standardised or at least agreed-upon protocols and standards in the coding, cryptology and interoperability. These three individuals view this standardisation as a key maturity requirement for the deepening of the talent pool in the blockchain development space.

4.4.1.2. Business cases and education

Eight of the eleven respondents stated that one of the key constraints to the growth of blockchain usage in the country is that there have not been sufficient strong business cases which have been brought forward. Strong business cases would warrant their respective banks diverting resources away from existing projects towards blockchain developments. One respondent eloquently explained the challenge as follow:

> *"…a technology will take off when a business case is made that will increase revenue & efficiency or decrease costs. Thus far, the proof of concepts that have been developed have arisen (primarily) from the technology divisions in the bank, with low levels of interest from (revenue generating) business units. For blockchain to truly take hold, business needs to request builds, and this can only take place if business understands the capabilities of the technology".*

This need for broader and deeper understanding of blockchain was also specifically mentioned by five respondents. Whilst the point about requiring strong business cases was repeated by many respondents, an additional insight was provided by one respondent that:

> *"…it must also be remembered that the revenue streams that blockchain is seeking to disrupt, such as transactional and payment fees, are currently a large component of the revenue of a bank. The business units do not have the incentive to change to new processes merely for changes sake – they will require a catalyst for change. This catalyst could come from a regulatory change, but more likely from competitive pressures".*

4.4.1.3. Skills development

The level and depth of skills in the South African development environment was listed by six respondents as the primary aspect which will need to be addressed in order for blockchain usage to further develop. This was further supported by the ten negative responses received in answer to the researchers question about whether there was adequate skill in South Africa to develop blockchain applications. All but one of these ten respondents qualified their statement by stating that they

believed that the South African banking industry could grow skills fairly quickly if the need for blockchain development arose (such as strong, deliverable business cases).

One respondent discussed that if the industry required the skill relatively soon, then it would be optimal to:

> *"…introduce the discipline at a university level, similar to the agreement that the bank had with UCT to embed data science into related academic programs of its curriculum. These programs were sponsored by the bank and the bank also sought to create graduate programs around this rare-skills pipeline"*

The respondent however emphasized that the bank had taken the decision to partner with UCT because they sought the skills to further their business offering to their clients. The respondent did not feel that blockchain development skills had reached the same level of requirement in the industry.

A second respondent stated that:

> *"…it was fairly simple to implement a standard or off-the-shelf blockchain solution, but would require significantly more resources than are currently working (on blockchain) in South Africa to develop a bespoke solution which could be utilised by the industry or country as a whole".*

The same respondent further stated that there were *"a few skilled consulting teams in some parts of the world"* which had been brought into the country to assist with a blockchain build for both proof of concepts and actual project builds. The respondent was highly complementary of Tata Consultancy Services in this regard. Another respondent provided information of the mutually beneficial arrangement that his bank had with a local consultancy, working together to build knowledge and skill in blockchain development.

4.5. Comparison to constraints in the rest of the world

All eleven respondents believe that these constraints were not unique to South Africa, with strong regard for the work being conducted in the American, European, Scandinavian, Israeli and Asian parts of the world. A significant number of respondents stated that they believed that South Africa had an advantage over the rest of the world in that South Africa had a concentrated banking industry with a few major players. This was allowing the industry to work closer together than other countries/regions, and thus would be quicker to establishing working industry-wide blockchains than other countries.

Despite this point, two respondents also described the opinion that the strength of South Africa's banking sector could be an excuse for not adopting blockchain (and other technologies) as quickly or wholeheartedly as other countries. To make his point, the one of the two respondents provided the example of the success of the mobile money application, Mpesa in East Africa – but with relatively low success levels in other parts of the world (including South Africa).

4.6. Summary of findings

The results from this interview process sought to address the two research questions related to the development of blockchain solutions in the South African banking industry. Whilst the respondents generally felt that the technology was still novel, there was a majority that felt that the industry could benefit from a wide-scale adoption of blockchain solutions in segments of their businesses. The respondents primarily sought the benefits of reduction in costs of payments, clearing and settlements; the reduction in the transaction time of trades and a gain in efficiency in clearing and settlement processes.

Whilst it is still quite early in the development curve within the South African context, the most common areas of the banks in which blockchain solutions are being developed for are in the Trade finance, Trading and Payments spaces. In keeping with the stage of development, much of the industry seems to be focused on the educating of business units as to the potential of the technology. This is to address one of the key factors which respondents cite as holding back further development – i.e. the relatively low levels of strong business cases for blockchain related services.

It seems evident that the future growth of blockchain development and adoption in the South African banking industry will in essence rely on the use-cases which are developed in the future. However the respondents were adamant that this does not imply use-cases specifically from South Africa – if the global banking market created value-adding products, services or platforms, then the South African banks would follow where applicable to their respective businesses.

5. Discussion of results

5.1. Introduction

The purpose of this chapter is to discuss and explain the results of the interviews with the South African banking system respondents, with reference to the literature review conducted in chapter 2 of this report. The data collected from the respondents, which was presented in chapter 4 of this report will be converted to information about the banking sectors ambitions for blockchain technology and their current perception of constraints to the mainstream adoption of blockchain solutions. Given the linked nature of blockchain technology, it was felt important to begin the discussion of results with an understanding of the level of collaboration taking place in the industry, its implications and benefits, and the interesting dynamic of leaders versus followers.

Thereafter, sections 5.3 to 5.6 aim to respond to research question 1 by looking at a) the South African banks reasons for researching the technology, b) its perceived impact on lending and credit capital and c) it perceived potential for cost savings in the South African context.

Section 5.6 concludes the chapter by reviewing the respondents' data on the technology development cycle of the technology in the South Africa financial sector context, by looking at aspects such developer availability, ability, resources being driven towards blockchain and a view on the openness of the South African financial sector to new technologies and methodologies.

5.2. Collaboration in blockchain development

From the information provided by the respondents, it is undeniable that all the major South African banks are at least ensuring that their blockchain knowledge is on par with the rest of their peers in industry. Whilst it is interesting that some of the banks are looking to launch, or already have an internally operational permissioned blockchain, only one of the banks stated that they had joined an international blockchain consortium. ABSA announced this membership with the R3 consortium in July 2016, with the respondent saying that the membership was easier to solidify given it's parent company, Barclays PLC's membership.

Whilst not an internationally linked blockchain, the major South African banks and other related parties in the broader industry (such as the SARB, STRATE and some smaller banks) have come together to join a basic South African banking blockchain, via which transactions are being tested. The SARB was given much credit for this collaboration given its openness to blockchain solutions, and its provision of a "sandbox" test environment for development on an industry stage.

Given the high number of respondents who stated that an industry-wide blockchain was one of the key changes required to further blockchain usage, this was confirmed to be a critical initial step for the industry. By creating the industry blockchain, the proponents of the technology have made the technology less intimidating for business participants. As discussed in chapter 4, eight of the organizations involved in the study (via their respondents) noted that the level of joint effort on a single project or concept was unprecedented in the industry.

This is in keeping with the literature of Pilkington (2015), which discussed the necessity of a single or multiple industry or international blockchains for the true benefits of blockchain to be realised.

However, the research found that whilst the majority of stakeholders to the transaction value chain are joining the SARB blockchain, some players are more active than others in the development of the technology in the industry. The research found that whilst all the respondents were keen to test transactions on the industry blockchain, three of the respondents commented that given the interest and allocated budget levels of their organizations, their organizations were satisfied to be "followers" as compared to "leaders" in the establishment and development of the technology in both the South African and global contexts. This is perhaps in keeping with the literature that key (and larger) major players will play a more pivotal role in global development, but is still surprising in an industry as small as South Africa. Sections 5.3 through to 5.5 below seeks to compare, contrast and make comment on the literature review and responses for interview questions focused on research question: **What are the factors about blockchain that banks are interested in?**

5.3. Reasons for adopting blockchain technology

The gains that the South African banking industry hopes to achieve with the implementation of blockchain are only tangible given the existence of legacy processes and friction in systems that have been built up over time as the financial markets have become increasingly complicated and correspondingly, increasingly regulated. These frictions and regulations are not unique to the South African industry however, but are inefficiencies that are present the world over.

It is thus of little surprise that amongst the first targets for blockchain solutions are those segments which experience the highest degrees of inefficiencies. As discussed in section 4.3.3 above, most of the respondents stipulated that the payments, trade finance and trading aspects of their businesses were these areas which experienced the greatest friction in operations – with these areas also being targeted for initial blockchain implementation in the international banks.

These initial segments are in keeping with the initial business lines suggested by the literature of MacDonald et al. (2016).

5.3.1. Shorter transactional paths

As discussed in section 4.3.2 above, one of the key factors driving banks to research blockchain is to reduce its transaction times. This, combined with a search for increased efficiency gains in a complex payment operational infrastructure made up a significant portion of the responses from the banks as to the reason for their interest in the technology.

The shorter transactional paths are of course, from the elimination of – or at the very least, a significant reduction in intermediary partners in a typical intra or international trade/payment due to the trustless characteristic of the blockchain transaction.

However it is in the rationale for bypassing these intermediaries that South African banks differ somewhat to the rest of the world. The researcher found that this was far more from an efficiency that could be passed on to their clients, and less from a motivation to reduce counterparty credit risk capital. It is worth repeating that seven of the eleven respondents interviewed stated that they anticipated any reduction in costs and efficiency would be passed on to their clients, with the remaining respondents expecting at least some of the gains to be passed on to their clients.

This is contrasted with the international banks, particularly in the USA, which according to the literature are focused on increasing trade speeds from counterparty credit risk capital (and cost of trade) perspective as discussed by MacDonald et al. (2016). The difference in motivation is understandable if one had to acknowledge the differing mix of businesses between the largest US and South African banks. In the larger universal US banks, a far greater portion of their revenue originates from the trading and other related businesses than South African banks. This can be partially due to differing capital regimes of the two countries, with South African banks experiencing a significantly higher capital charge for the e.g. proprietary trading business.

5.3.2. Cross-border transactions

The research confirmed that the South African banks are also seeking easier cross-border transactions as one of the benefits of their blockchain development. Whilst not a key driver for the technology's development in the country, the transfer of funds across borders in the African-India corridor is nonetheless an important contributor of revenue for the South African banks. As one respondent commented:

> *"South Africa is still a powerhouse in the region. The country's industries thus still attract talent and labour from across the continent, and perhaps the world. These individuals, these diaspora still send significant amounts of money to family back in their respective countries – and whilst we of course facilitate these cross-border transactions, they are unfortunately expensive to conduct".*

This statement was repeated in various forms from all respondents and is consistent with the literature of Shrier et al. (2016) which discusses the significant cost reduction (from reduced intermediaries and other reconciliation costs) expected from a global blockchain. These costs impacts are discussed further in section 5.5. below.

5.3.3. Crypto-currencies

From the research, it is fairly evident that there is little interest in Bitcoin itself from the banks. Whilst no respondent specifically stated that their organisation was interested in Bitcoin or other existing cryptocurrencies, there is work being conducted with the SARB to investigate the role of a (or multiple) cryptocurrencies in the South African economy. However, contrary to the literature of Crosby et al. (2016), this interest is less about the security and immutability of a cryptocurrency, and more about the conceptualisation of a more liquid transaction ability. When speaking about the interest in cryptocurrencies in their particular organisation, one respondent stated:

> *"…the interest (in cryptocurrency) is not about replacing money in the bank, but rather replacing money in your wallet – and most importantly, how you spend it. A key aspect of any currency, crypto or traditional, is the currency being used in transactions in a wide enough group of people willing to accept and hold it. This creates liquidity and trust in a currency. However, in order to transfer a currency through time* (i.e. ensure its value in the future)*, we* (banks) *need lend it... and at the current stage, the market of individuals willing to sell a house for Bitcoin is too shallow for us to enter as a market maker".*

In addition, another respondent elaborated that the research team had pitched a Bitcoin related product to the business segments, but was turned down given the lack of interest from relationship managers (on behalf of clients). Whilst this was in 2014, the respondent said that there hasn't been other interest in cryptocurrency (existing or new) from within the bank since. In addition, it was interesting to note that the respondent felt that this was probably partially due to the team pitching the idea too early in the technology life cycle for business and clients to be excited by it – and thereby hurting future pitching opportunities.

Contrary to comments by Pilkington (2015), the respondent felt that the levels of distrust in banks present in the developed market countries were not as severe in South Africa. Thus whilst in these countries, Bitcoin (and other cryptocurrencies) were being used as a store of value, South Africans were instead using it as an instrument and mechanism to circumvent inefficient transactional infrastructure (and for speculative currency trading).

Finally, a further two respondents stated that it was unlikely that a single bank would launch a cryptocurrency given the closed pool in which clients could transact (again referring to the depth of liquidity of a currency for there to be legitimacy). One of the respondents added that as it stood, all the major South African banks already had digital currencies of their own (such as ebucks, greenbacks, U count rewards etc.), but that these were treated as reward options or currencies rather than a standalone currency from the Rand. In addition, these digital currencies were limited to the amount that the originating bank or the participating retailers provided on their respective balance sheets. Whilst this was thus not a true form of a cryptocurrency, it was interesting to understand that the majority of South African bank management associated the digital currencies in existence to blockchain related currencies.

5.3.4. Blockchains enhanced security

As discussed in the literature of Driscoll (2014) and Crosby et al. (2016), the enhanced security of blockchain is one of the key reasons the technology is being undertaken by banks across the world. The ability of the technology to be extremely difficult to manipulate once a block has been agreed by the network of nodes is seen as a major enhancement of security by banks, especially given the traditional multi-systemed (and thus multi-ledger) computer networks currently used by major banks today. However, the researcher found that this enhancement of security to not be a key reason for South African banks to be researching the technology.

As discussed previously in exhibit 2, a reduction in total risk for the bank was only cited by three of the respondents. Even in these three positive responses, there are caveats to the type of risk reductions that the respondents saw for their organizations. In his work analysing the operational risk impact of distributed ledger technology, Stradling (2015) expects a decrease in the potential for operational break-down. Whilst the three respondents believe that certain operational risks such as manual process failure and some types of fraud should decrease, other risks such as cyber security could increase in magnitude to offset this.

One respondent stated that:

> *"…as with any new technology or process, there are generally new risks which present themselves as the technology develops and embeds itself within the broader organisation – blockchain should not be expected to be any different. If one took an exponential view on the use of the technology, it can assuredly be expected to replace a significant amount of people in the audit and general reconciliatory finance areas. So whilst there should be the decrease in human error, what happens if machine error presents itself in some form? And to compound the scenario, what happens when*

machine errors present themselves in an immutable technology such as blockchain? How does one correct this error in those cases?

Another respondent, with a role in his company's cyber security division, stated that whilst he believed that there would be a reduction in fraud given the almost prohibitive processing power required to change a series of data points, he also knew that even the most secure technology would eventually fall prey to sophisticated fraudsters. The respondent elaborated that

> *"…it is logical to expect fraud syndicates to only begin attacking new technologies if the reward was worth the effort, and as there are relatively small amounts of assets on a blockchain around the world, syndicates had not begun to turn their focus on to blockchain as yet"*

Finally, none of the respondents expressed the desire to be part of, nor start an open (non-permissioned) blockchain. This by definition meant that risks such as the 51% attack mentioned in the literature review was certainly real, but would present itself differently in a permissioned blockchain than it did in a public blockchain such as Bitcoin.

5.4. Blockchains impacts on lending and credit capital

In the literature, Shrier et al. (2016) and Stein (2015) discussed the potential – and expectation for blockchain to enable increased collateralization in the retail and SME client segments. Stein (2015) elaborated that a key factor for this is the unwillingness for banks to consider movable assets as collateral – and further discussed the potential for using the blockchain to establish asset registries for use as non-traditional collateral. As discussed in section 4.3.4, this was confirmed in this study, with seven of ten respondents believing that substantial increases in lending through new collateralization was possible – particularly in countries with weak or no existing asset registries. However, it must be noted that only two believed that this increase would be meaningful in countries with strong existing asset registries, such as South Africa.

When asked why they believed that markets without asset registries would be the beneficiary instead of South Africa, the majority of respondents stated that the lending rules in the rest of the African continent was more flexible given the low levels of formal, structured data in existence in many of these countries (both in West and East Africa). Thus, whilst immovable assets would still be preferred, lenders in these countries (including the respondent banks) would be more willing to include movable collateral in SME deals.

Finally, the retail bankers in the respondent group were particularly steadfast in their belief that the blockchain could unlock collateralization in frontier markets. Their belief was that blockchain could allow many developing countries to leapfrog the traditional (expensive) set-up of a physical asset registry, and move directly onto a digital registry on a blockchain. This would allow a significant amount of land and houses to be registered, and thus placed as collateral for further lending from the banks – with lower capital requirements in time, given lower LGD (Loss Given Default) estimates in the capital calculation (discussed in chapter 4 previously).

It was however emphasised that there was not currently a view that blockchain technology would directly lower the PD (Probability of Default) of a client. Another respondent stated that for the industry to experience the decreased LGD benefit, it would be imperative for all banks in the country/industry to have access to the asset registry so as to benefit from the smoother transaction ability afforded by the technology – and thus experience the credit capital reduction.

5.4.1. Public sector support

Another finding consistent with the research of Shrier et al. (2016) was that all eleven respondents believed that a key factor for these asset registries to be developed was the political will and support of the respective countries governments to implement blockchain solutions. Whilst four of the respondents stated that their respective organisations had begun exploratory research into these types of registries, there was little expectation for government organisations to take up the technology in the near future. Two of these respondents further discussed that this expectation was from the fact that some government organisations generated revenue from inefficient processes, and thus they would protect revenue streams, at least initially. Finally, one investment bank representative did emphasise that the moving of grain and other soft commodity assets onto the blockchain would be fairly straightforward, if the industry desired it.

5.5. Blockchain cost savings

As discussed in the research by Oliver Wyman (2016) and MacDonald et al. (2016), there is an expectation of significant cost savings for the global banking sector. Oliver Wyman (2016) expressed their expectation that these savings would not only originate in the increased efficiencies in the transaction & payment processes, but almost certainly also from decreased staff requirements in certain areas of the bank, more specifically, the areas responsible for reconciliation of transaction. In this research, it was found that nine out of the eleven respondents agreed with the literature that there would be some cost savings from a blockchain implementation. However, the research found that there were important differences and caveats to their agreement.

The first of these was that all respondents believed that for the transaction savings to materialise, the global (or at least industry) blockchain would have to exist first. Whilst this does not explicitly differ from the research of MacDonald et al. (2016), there was material reluctance to agree to the inevitability of these savings as it depends on a significant amount of collaboration first.

Secondly, five of the respondents specifically answered questions about cost savings using a long term/short term approach. These responses took into account the development cost, and the implementation costs, likening it to a typical new system introduction and integration. As one technical respondent discussed:

> *"In the long term, if we can work together to build an industry blockchain, this would certainly reduce costs given the distributed ledger philosophy. However, in the short term, there would be additional costs for the bank – ranging from increased development and related research cost, to implementation costs. In addition, given the fact we* (banks) *hold a significant amount of our clients personal information, there is no doubt that we would need to run both the legacy system and a new blockchain in parallel for a substantial amount of time in order to build confidence in the new approach both internally and with our clients, regulators and shareholders".*

This duplication of effort, whilst wasteful from a systems thinking point of view, would be necessary to provide comfort to all stakeholders. Thus, there would be a period of increased costs, and less efficient processes (including reconciliations between the two processes) before the true gains to the industry are experienced.

The third aspect of difference to the research of Oliver Wyman (2016) was in the discussion of job losses, which would reduce the salary costs of the bank. Whilst most respondents agreed that in the long run, there were three respondents who raised the point that increased software development (blockchain and other) would also necessitate an increased developer staff complement. Given the novelty of the blockchain technology, and the extremely small pool of developers able to jump immediately into blockchain development, this skill would, at least initially be expensive. This would offset the savings in the short-to-medium term, but all three agreed that this cost could decrease as well as increased amount of developers entered the field, and the banks moved past the expensive development and implementation phase.

Finally, one respondent, who is a part of the risk management segment of one participating bank, also made mention of the fact that finance staff who were displaced in reconciliation roles would most likely move to other reporting roles within the banks, particularly given the rise of regulatory

requirements in the banking sector. The respondent stated that he was without doubt that these regulatory requirements would increase over time, and thus whilst blockchain may relieve the burden of one finance function (reconciliation), other (regulatory) functions may need alternative technologies to assist – emphasising that blockchain was not a silver bullet solution for all challenges in the industry.

5.5.1. Interfacing challenges with existing systems

Given the potentially large amount of software development that will be required to embed blockchain technology into the banking industry, the researcher felt it appropriate to question whether there would be significant challenges to linking the novel blockchain technology to existing systems. None of the six respondents to the question believed that the industry would face much difficulty in linking their existing systems and platforms to the technology. The more technical of the respondents felt that via the use of middleware and other interfaces, the linking of the new and existing systems would not be more challenging than any of the projects that their respective entities had previously handled. Sections 5.6 below seeks to compare, contrast and make comment on the literature review and responses for interview questions focused on research question 2: **What do banks feel are the current restraints to blockchain implementation in the industry?**

5.6. Blockchain technology development cycle

A key component of the research conducted by Shrier et al. (2016) is the expectation that there are sufficient skills, resources and will available to deploy blockchain solutions in every desired aspect of the payment and broader banking value chain. Given the criticality of this expectation, the researcher felt that it was important to raise the question of whether South Africa is appropriately positioned, both in terms of skill and other necessary "building block" requirements to take advantage of the new technology. As discussed in chapter 4, there is significant effort being put into the education of the respective business units. This is key, given that eight of the eleven respondents stated that strong business cases are a necessary component for bringing blockchain into the mainstream, and therein attracting skill into the field. This would be a "pull factor" for skilled developers given that this would provide new and interesting projects on which to work on.

5.6.1. Blockchain developer availability

Whilst this is not in contradiction to the research by Shrier et al. (2016), it does seem that there is a lag in mainstream take-up when compared to the USA (where the research of Shrier et al. (2016) is focused), if one compared the stage of blockchain awareness in the South African banking sector to that of the broader sector across the world. Thus, whilst the expectation that the developmental skill could be attracted to the field in South Africa once some measure of a critical mass of projects amass, this is not the case at this point in time according to the respondents interviewed. When

asked whether South Africa had enough adequately skilled individuals to develop large-scale blockchain applications, ten of the eleven respondents did not think so.

However, this could again simply be a timing delay between South Africa and the other countries as three of these same respondents stated that they felt the talent within their existing developer-pools could be modified quite easily to develop blockchain solutions – when the need arose.

5.6.2. Blockchain development ability

A caveat to the previous statement however, came from two other respondents who stated that whilst they also felt that the skill could indeed be easily modified, this would only be a temporary solution. The respondents elaborated by saying that this modified skill would be adequate for the initial basic building of blockchain infrastructure – the *"off-the-shelf"* solutions, as one respondent discussed. Thereafter, dedicated developers – trained in blockchain and its nuances, would need to be introduced to truly develop, and thus embed the technology within the South African banking sector.

When asked what could be done to aid the growth of the blockchain development talent pool so as to be comparable to that expressed in the literature of Shrier et al. (2016), the respondents answers were surprisingly subjugated. Besides the need for further education within the businesses (so as to prompt more business cases), there was only one respondent who suggested that there was a need for formalised academic programs (or similar) – at this stage. Another respondent suggested that more sandboxes would be beneficial for combined growth of the pool, but added that this is true for all nascent technologies and not just blockchain technology.

5.6.3. Banking resources channelled towards Blockchain

An important point that needs to be raised with regards to Shrier et al. (2016) literature was discussed by two respondents from different banks. Their opinion was that South African banks in general, were currently not providing an adequate amount of resources towards the advancement of the technology in the industry. The respondents added that given "*…the current level of interest - and the **current potential revenue uplift perceived** by the industry, the resource allocation was perhaps acceptable, but that adequate was not enough to change the industry in a meaningful way*". Both respondents felt that given the significant effort being put into blockchain education, the perceived revenue uplift/cost reductions will become larger in time and thus, banks would feel more comfortable to dedicate further resources to this technology.

As a final point, the respondents that there two additional factors which was impeding the resource allocation towards blockchain – the first being the fact that blockchain in its purest form would reduce existing fee & commission income lines within the industry, and of course it was not in the

business units best interest to cannibalise existing income for potential future gains. The second was the fact that, at its present point on the technology life cycle (or perhaps the Gartner Hype cycle), blockchain was simply not seen as a "sure-thing" for business (and thus the industry as a whole) to dedicate material portions of their R&D budgets on. As one respondent with significant experience in software and technology development and project management within a major South African bank pointed out:

> *"Fintech is the new, new thing for banks. The problem however, is where to focus your time, resources and effort. Blockchain is novel, interesting and is perhaps the technology with the greatest potential for widespread adoption – but banks are risk managers, and we are hedging our bets by investigating all forms of fintech. That is why, to my knowledge, all of the players in the industry, have a combined budget for fintech – and not specifically for blockchain. And this will probably remain the case until a critical mass in the industry tells us otherwise"*.

6. Conclusions and recommendations

This study is concluded in this chapter with a summary of key findings from the South African financial sector respondents. The purpose of this study was to understand the reasons for the industry researching the technology, and to obtain its view on the perceived constraints to its mainstream implementation in the sector. Thereafter, the chapter presents implications for the industry and concludes with recommendations for further research.

6.2. Summary of findings

The study found that the South African banking industry was at the very least ensuring that their knowledge base on blockchain technology remains on par with their peers in the industry. In addition, the banks which were at the forefront of the technology in the South African industry had developed permissioned distributed ledgers, with some joining external and international consortiums in a bid to leverage the experience and true potential of a global distributed ledger. The industry has enjoyed an unprecedented amount of collaboration around this technology and this has been cited as the reason for the speed of adoption in the South African context.

Whilst the industry has multiple reasons for pursuing the technology, it was common amongst the respondents that they sought efficiencies in the portions of their businesses which were seen to have the highest levels of friction. The banks sought shorter transactional paths via the elimination or reduction of third party intermediaries. The key attraction of this reduced intermediary involvement was the reduction in costs and gains in efficiency which could be passed onto their clients – as opposed to the increased trade speeds sought by the international banking groups.

The banks did see a significant reduction in costs arising from these shorter transaction paths for the African diaspora within South African – admitting that the costs of these trades are still punitively high, considering the relatively small values being transferred by the diaspora client base.

It was interesting to note the banks lack of interest about Bitcoin in particular, with marginally more interest in cryptocurrencies in general. Whilst there is work being conducted with the SARB on the topic of cryptocurrencies, the emphasis is rather more on the conceptualisation of more liquid transactional ability than the security aspect of the currency. It was particularly interesting to note that whilst much of the enthusiasts viewed Bitcoin as an alternate store of value to gold, South African Bitcoin traders were utilising it as a means to circumvent the perceived inefficient and expensive transactional infrastructure.

The study found that whilst the security of the blockchain technology was a key driving factor of the industry's research, there was not an expectation that blockchain was the answer to all security

concerns. As expected, there were differing levels of security concern with permissioned and un-permissioned blockchains, with the concerns ranging from operational or process failure to intentional manipulation of blockchains. In addition, the research found that whilst the technology would be instrumental in reducing human error – by reducing reconciliation processes, there would necessarily be increased machine errors which would present itself. The research found that in general, risk officers in the industries were concerned about what the referred to as the "unknown unknowns" – i.e. whilst they knew that such technology would present new risks in time, there was concern that until these presented themselves, the forerunners in the industry would potentially be significantly exposed to predatory attacks (from fraud syndicates and the like).

The research found that whilst there is currently not perceived to be adequate skill in the field in the South African context, there is significant amounts of developmental work taking place to build the skill for the future. There was an expectation that the first movers would have to utilise developer skill which would be modified from another software expertise. As the technology demands increase, specialised consultant skill would need to be introduced to garner momentum in the field, with the eventual aim being to introduce in-house specialised skill as the technology becomes embedded.

The research found that it was not believed that adequate resources were being channelled towards blockchain development. Furthermore, it was perceived by the respondents that this was in a large part due to the belief that given the level of interest, revenue uplift and benefits to the broader industry, banks were hesitant to channel their entire R&D budget (or even a significant portion) towards a single bet on future technology. Finally, the research found that an additional impediment was the fact that there was short-sighted focus on the loss of revenue which would occur from the cannibalisation of existing product lines if blockchain was implemented as expected – as opposed to the far-sighted view of additional product and service offerings which could be launched in the future.

6.3. Areas for future research

This research focused on the views of eleven participating respondents based in the Johannesburg area. Whilst this area is a concentration point for the industry, there are banks in other parts of the country which could have alternative views. Given that the majority of these other banks are the smaller banks – with the exception of Capitec Bank, it is highly possible that these banks would have alternative usages for the technology given their simpler and more pliable systems as well as the fact that these banks are expected to have lower attachments to traditional banking limits and thinking.

Furthermore, given that the technology is still quite new, there is expected to be significant changes as the industry assimilates to the technology. It is thus recommended that further research be conducted as the technology develops and the South African industry adapts to it.

Similar research could be conducted with developed market banks, and perhaps other peer developing market banks so as to gather a more holistic view as to the directionality of the technology.

6.4. Recommendations

- It is recommended that bank participants continue to engage with each other so as to create synergies in the research process, particularly given the distributed, and thus shared, nature of the technology.

- From the research, the SARB's involvement in the development of sandboxes and other combined resources has been quite beneficial in the progress made in the technology's development. This continued engagement is thus encouraged, and in addition, further pre-emptive engagement specific to the regulation of such technologies is recommended.

- It is noted that one of the key drivers for blockchain technology deployment is the efficiency gain and cost reduction of financial transactions (both within and outside any given country). The research has shown that the banks will remain interested in the technology as long as it is perceived to be able to provide such gains. By implication then, if there is another technology which could provide greater gains, the banks would delve into this technology. Thus, it is recommended that the South African banks remain cognisant of other developing technologies which would be able to provide similar gains.

- Finally, whilst Blockchain technology may not be the solution for all technology issues and challenges, the technology certainly has the potential to simplify specific aspects of the banking value chain, and additionally bolster the security of the entire transaction process – if it is possible to implement as envisioned. Thus it is recommended that the banks direct resources greater than that currently directed towards the research, as it seems that the technology is past Gartners Trough of disillusionment and is steadily moving up the slope of enlightenment towards widespread embedment in the banking world.

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Appendix A

Research Instrument: Interview schedule

1. How long has your organization been involved with blockchain technology?
    a. *Are you partnered with any major blockchain consortium?*
    b. *What are factors that have led your business to look at blockchain solutions?*

2. Which are the segments of your business that you are looking at blockchain solutions for?
    a. *Why are these business segments being targeted first?*

3. What are the blockchain related activities that your business is busy conducting?
    a. *What are the benefits of blockchain to your business?*
    b. *How do you see the banks clients benefit from blockchain implementations?*
    c. *Is your business looking to link with, or launch cryptocurrencies?*

4. Some EM countries have begun using blockchain distributed ledgers to establish/fortify their asset registers so to unlock their collateral value in lending. Do you think that blockchain can have an impact on lending in the South African industry?
    a. *Is your industry working on asset registries?*
    b. *Are you partnering with government to develop blockchain-based registries?*

5. Do you think blockchain can have a significant impact on banking globally? And in South Africa?
    a. *Do you see blockchain having any negative impacts on business lines in general, and on your own business in particular?*
    b. *What cost implications do you think blockchain can have on your business?*

6. What capital implications does your business think blockchain will have?
    a. *This is both from a capital generation perspective and a Risk weighted asset perspective.*
    b. *RWA impact from both an operational risk and credit risk (or other risk) perspective?*

7. What are the immediate and long-term changes required to development mainstream blockchain usage in the country
    a. *What are the constraints to development of blockchain in South Africa?*
    b. *What are your thoughts on the complexities of linking blockchain solutions to legacy systems?*

8. Is there adequate skill in South Africa to development blockchain applications?
    a. *What can be done to aid the growth of the blockchain development talent pool?*
    b. *Do you think that banks are providing adequate resources towards blockchain development?*

9. Do you think these constraints are unique to South Africa?
    a. *Please elaborate if your answer is "Yes"*

10. How does the local blockchain environment compare to the global environment?

11. Do you have any other comments that you would like to share on blockchain?
    a. *Are there other blockchain applications outside of the financial sector that you are tracking?*

Appendix B

Interview Consent form

Title of research project:

An analysis of the outlook for Blockchain technology in the South African banking industry

Name and position of researcher: *Please initial box:*

Avish Brijmohun, Final year part-time MBA student, Wits Business School

1. I confirm that I have read and understood the electronic information sheet I received for the above study and have had the opportunity to ask questions of the researcher. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any given time. ☐

3. I agree to participate in this study. ☐

4. I understand tha my personal details such as my name, employer name, and employer address will not be revealed to people outside the project ☐

5. I understand that my words may be quoted in publications, reports, Web pages and other research outputs but that my name and Employer name and address will not be used ☐

6. I agree to the interview being audio recorded. Yes ☐ No ☐

   Please tick box

Name of participant: Date: Signature:

Avish Brijmohun (Researcher): Date: Signature: