Understanding and applying Blockchain technology in banking: Evolution or revolution?

Received (in revised form) 12th April, 2016

Mark Buitenhek
is Global Head of ING Transaction Services, an important growth area for ING Wholesale Banking. The products and solutions include integrated cash management products and channels, trade finance services and working capital solutions. Previously Mark was Global Head Payments & Cash Management for ING, where he was responsible for setting the overall business architecture, managing the extensive product portfolio and defining new products and services. He has more than 25 years of experience in banking, particularly in the payments, cash management and cards industries. Over the years he has led many payments initiatives as well as strategic projects and change programmes in both the Retail and Commercial Divisions of ING. Mark participates in several European payments and cards committees. For more than six years he chaired the Payment System Committee of the Dutch Bankers' Association and the Dutch Steering Committee on the introduction of Single Euro Payments Area (SEPA). He is also a member of the SWIFT Board of Directors, the European Payments Councils' Plenary, the Equens Supervisory Board and the MasterCard Board Europe.

ING Commercial Banking, Global Head Transaction Services, Location code AMP M 01.004,
Bijlmerplein 888, 1102 MG, Amsterdam, The Netherlands
Tel: +31 20 576 1600
Email: mark.buitenhek@ing.com

Abstract This paper explores the emerging technology of blockchain, the technology that underpins Bitcoin and other cryptocurrencies looking at what the technology is and its potential to disrupt and transform the financial services industry. It highlights the technology's characteristics and explains why these can have a profound impact on the entire financial sector in areas ranging from settlements, payments and identity services, as well as creating new products based on for example 'smart contracts'. It will give readers an idea of what stage the technology is at—at the top of the Gartner hype cycle and therefore due to enter the 'trough of disillusionment' before useful applications start to emerge. The paper also highlights the work that the industry needs to do to make blockchain applications a mainstream part of the financial landscape. It stresses that this is not a technology that a single organisation can hope to perfect to gain an advantage over rivals. Rather, it can help the entire industry by speeding up transactions and making them more secure. But its full potential can only be realised if there is widespread collaboration throughout the sector to explore applications and create common standards.

KEYWORDS: blockchain, distributed ledger, smart contracts, collaboration, FinTech, finance, trade finance, settlement and payments

INTRODUCTION

If 2015 was the year in which blockchain was the financial sector's buzzword, 2016 is set to be the year when the industry starts to cut through the hype and work out how useful blockchain will actually be.

The year 2015 saw an evolution in the financial sector's thinking about blockchain, which is best known as the technology that underpins the cryptocurrency Bitcoin. That thinking moved from: 'Is Bitcoin a threat?' via 'should we be looking at the technology

underlying Bitcoin?' to: 'we have to explore how blockchain technology can be of value for customers, processes and in the financial industry in general'.

ING recognises, however, that for blockchain to become an important part of the financial system, collaboration across the industry and along the value chain is necessary. This is in line with the recent trend for large market players to come together in an attempt to speed up, influence and understand the spread of the technology.

Having spent 2015 talking about blockchain, this is the year that the technology will be put to the test. Uses have been and will still be tested throughout 2016 and some of them have already fallen and others have succeed.

WHAT IS BLOCKCHAIN AND WHAT CAN IT DO?

Blockchain technology was designed to solve four problems:

- Double spending
- The issue of trust
- Consensus on the latest correct version of the transaction history
- Preventing anyone from making a change to an agreed chain of transactions

The blockchain is a constantly updated public ledger of transactions in a given system (Figure 1). It logs any transaction within a peer-to-peer network in such a way that it cannot be altered or tampered with. It is transparent, allowing transactions to be processed in a decentralised manner and removing the need for a central authority to verify trust and the transfer of value (eg money).

Its best-known application is as the technology underpinning Bitcoin, which had financial institutions scrambling to understand its implications when it first emerged. Interest in Bitcoin has waned because of high price volatility, however, a low level of acceptance and the fact that bitcoins are often instantly being converted to fiat currency, among other reasons.

But this declining interest in and fear of Bitcoin was coupled with a growing interest in the technology behind it and its potential to create new opportunities for banks as well as new threats to their business models.

Santander InnoVentures, the FinTech investment arm of the Spanish bank, has identified 20 to 25 applications of the technology and estimated that it could cut banks' infrastructure costs by up to US$15bn to US$20bn a year by 2022.[1]

1	**Capital**	• Increase in capital efficiency
2	**Immutability**	• Durability of records with no ability to censor data or change data
3	**Inviolability**	• No opportunity for multiple versions of truth
4	**Control**	• Control is distributed to all members on the distributed ledger
5	**Distribution**	• Transactions are simulcast to all members of network-data and assets to each network node
6	**Cost**	• Looking for exponential decrease in frictional costs
7	**Compliance**	• Compliance is implicit in ledger as is audit and regulatory access
8	**Clarify**	• Potential for native smart contracts or smart contract overlay to bind transactional data

Figure 1: The leverage from a distributed ledger infrastructure

Source: Celent —blockchain in capital markets.

There is clear potential for blockchain applications in a variety of banking and finance contexts, including securities and trade settlement, internal transacting, e-identity and also as a backbone for connected devices. Even though the technology is very new, there have been enough examples and tests that show it can work. The main question the industry is facing at the moment is if and how it will work. The industry is still unsure exactly when and where blockchain will get its first foothold.

DISTRIBUTED LEDGER—DECENTRALISED TRUST

One of the major characteristics of the technology is that it is a distributed ledger among the participants of the network. 'Distributed' in this case has a particular meaning—that the data of the ledger (transaction history) is not stored in a centralised location that controls access to information. Instead, every participant can have a complete (or partial) copy of the ledger and access all the included transactions. This means that there is no single point of failure but also that there is a single source of truth that is constantly updated and used to extend the chain with new transactions. This makes it impossible to go back in time and try to corrupt transactions.

The 'decentralised trust' that this creates eliminates the need for any centralised authority and brings the source of legitimacy in the realm of finance back to participants.

This could create a serious threat to the rationale for central clearing houses. Trades today are often verified by a central clearing house that maintains its own central ledger. Using that process, it can take days to settle a transaction, and the clearinghouse typically collects some kind of fee. Blockchain technology could eliminate that by giving each bank in the network its own copy of the ledger. A common network protocol and consensus mechanism would allow participants to communicate with one another. Using this method, transactions could be approved automatically in seconds or minutes, significantly cutting costs and boosting efficiency.

However, just because blockchain can solve certain problems, that does not mean it is the best way of doing so. The value case has to be clear and compelling to make it worth tearing down various parts of the financial sector's well-developed infrastructure.

There are clear indicators that certain markets can be transformed using blockchain technology, particularly those characterised by long processes, multiple handovers, large numbers of parties involved and intermediaries.

But with blockchain technology, more than ever before, we need to work together across the industry and across value chains to really gain the benefits of the technology. The nature of the technology is such that the value increases when it is applied to larger numbers of parties. Because the technology is so new, it is also vital to involve regulators as early in the process as possible and to set standards that can be adopted throughout the industry. Standards are important to reduce complexity and avoid integration costs.

AT THE TOP OF THE HYPE CYCLE

Using the methodology of Gartner's 'hype cycle', the blockchain is right at the Peak of Inflated Expectations, having risen very quickly up the agenda in 2015 (Figure 2). Everyone was trying to figure out what blockchain is and what its impact might be. At this early stage, all possibilities were open. Now it is set to slide into the Trough of Disillusionment, which will see the possibilities narrowed down and a new realism return to the discussion. The discussion during the course of this year has been set to move on from 'Why Blockchain?' to 'How can the technology solve our problems?'

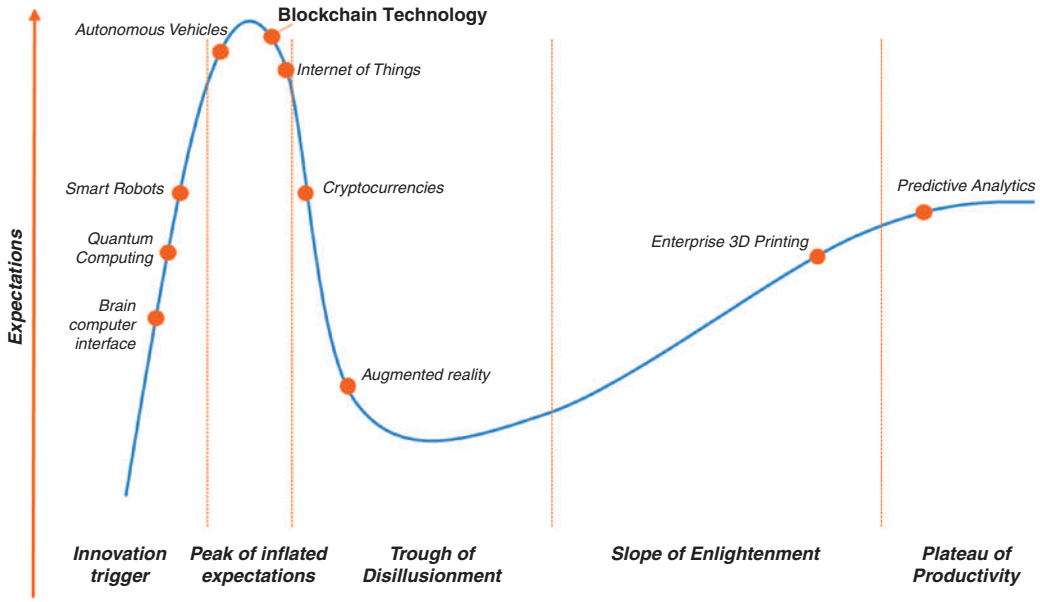

Figure 2: The blockchain technology

The next stage is the Slope of Enlightenment, where the applications that will really take hold start to show their potential. Once these applications are bedded in, the hope is that blockchain will move on to the Plateau of Productivity and become an established part of the industry.

AND IN PRACTICAL TERMS, THIS MEANS . . .

Because a blockchain can be shared within a network but not tampered with, participants have insight into the status of transactions at any given time. On top of that, blockchain allows any party to add a transaction to the ledger, but only according to strict rules and if a majority of participants agree that it is valid. This means that everyone can directly send something of value (eg money) to anyone on the network without the need for a central controller or central clearing. This, in turn, should make transactions much faster and cheaper.

But there is another benefit. Blockchain allows the creation of 'smart contracts'. Chunks of code can create a logical pathway that allows certain actions to happen automatically once certain conditions are fulfilled—for example, payment of goods can be authorised once they arrive at a port.

The potential applications of blockchain are not limited to the financial sector. In general, blockchain technology has potential when:

- Proof of ownership is important and this ownership needs to be transferrable.
- There is a lack of trust between parties.
- There are many bilateral relationships and parties on a market.
- There are different types of assets that interact.
- These assets move across organisational boundaries.
- Processes are highly manual or paper-based.
- Processes have many steps, intermediaries and handovers.[2]

Suggested applications include bringing transparency to global supply chains, particularly for high-value and/or potentially

controversial products such as diamonds. Everledger is a permanent ledger for the certification and transaction history of diamonds; it can track diamonds that have been stolen or mined in conflict areas such as the Democratic Republic of Congo. The technology could also be used to ensure that food products are organic, to create digital assets ranging from stocks and bonds to frequent flyer miles, audit trails for healthcare, to create tamper-proof digital identities, and to keep track of electricity production on a distributed grid where homes are both producers and consumers of energy. It could even be used to make elections harder to rig.

Nonetheless, it is the finance sector that is set to see some of the biggest impacts from blockchain. Blythe Master, the former JPMorgan banker who helped develop credit default swaps and is now chief executive officer (CEO) of blockchain developer Digital Asset Holdings, told an investor conference in 2015: 'You should be taking this technology as seriously as you should have been taking the development of the Internet in the early 1990s'.[3]

FOUR-STAGE ROLL-OUT

McKinsey, in a new report called *Beyond the hype: Blockchains in capital markets,*[4] says the mainstreaming of the technology will advance in four stages, starting with internal purpose-built distributed ledgers that operate within enterprises.

This would be followed by the adoption of blockchain by a small subset of banks as an upgrade to manual processes, starting with assets that are traded infrequently and manually over the counter. This would help participants agree on standards and protocols for booking and transfer with relatively little investment.

Next would come the conversion of inter-dealer settlements, which would help solidify the standardisation of products, followed by large-scale adoption across buyers and sellers in public markets, which McKinsey says 'would be a great leap forward and would depend on large-scale conversion of existing systems and adoption by a large number of market participants'.[5]

McKinsey makes four recommendations for immediate action:

- Assess the impact on your business and plan for the long term.
- Participate in consortia and work with regulators. The pay-off for cooperation over co-opetition may be industry utilities and faster development cycles.
- Capture the internal ledger opportunity: this would give individual firms the opportunity to test new technology on systems already being revised and develop expertise without concern for network issues.
- Go after post-trade and manual processes. These can yield significant workflow benefits and be less disruptive to business models.

COOPERATION IS PARAMOUNT

McKinsey, like many others, suggests that the blockchain is not a technology that will enable one organisation to come up with a new category killer product or process that will give it an advantage over its rivals. Rather, its success 'will require cooperation among market participants, regulators and technologists'.[6] The greater the number of businesses around the table, the greater blockchains' impact will be.

It is for this reason that ING is part of the R3 Consortium of over 40 banks 'focused on building and empowering the next generation of global financial services technology'. The group, in the first test of its kind, recently successfully trialled five distinct blockchain technologies in parallel. The trial, in which the banks connected to R3-managed private distributed ledger technologies built by Chain, Eris Industries, Ethereum, IBM and Intel, 'marked an unprecedented scale of institutional collaboration between the financial and technology communities exploring how

distributed ledgers can be applied to global financial markets', the consortium said.

David Rutter, CEO of R3, added: 'This development further supports R3's belief that close collaboration among global financial institutions and technology providers will create significant momentum behind the adoption of distributed ledger solutions across the industry.[7]

PAYMENTS

Using blockchain to disrupt the payments business is an obvious area of interest. Many have started thinking about blockchain technology with a payments use case in mind. Experience has, however, shown us that it is not that easy to change this very complex, and sometimes costly, business. Before we see any implementation of blockchain technology in payments, we will need to solve a number of 'market problems'.

Many experiments have shown us that technically a great deal is possible. Yes, we can connect and share ledgers. Yes, we can instantly send and verify a transaction. Yes, we can create payments chains that cut out several intermediaries. But the difficulty with payments is that the asset 'money' is one of the most regulated assets we have in the world. These regulations are part of the reason current processes are what they are, and simply introducing a new technology with disruptive *potential* will not change the requirements for banks.

Many regulations are also there for a good reason, to manage risks between parties, to manage risks that are of a larger scale (systemic risk), and so on. What blockchain technology does is show how things could be different and force us to have those discussions. But, in the end, it all boils down to the acceptance of whatever virtual currency, or virtual representation of a fiat currency, is traded on a blockchain—acceptance not only by regulators but also by other banks, by organisations and consumers.

In the world of cross-currency payments, the model is complex. As the distributed FinTech company Ripple says: 'International interbank funds transfers rely on a series of correspondent banking networks which introduce multiple layers of fees, counterparty risk and settlement delays.'[7] This is mainly due to the fact that trust relations need to be created by banks bilaterally. A blockchain brings the advantage that banks can create trust towards an entire network.

Adoption will happen in several phases, where inter-bank payments solutions are being adopted before full peer-to-peer solutions. In part, this is because a certain level of trust already exists between banks and other financial institutions, while that trust has not yet been established in the peer-to-peer economy. Where trust exists, blockchain can improve transparency and bring operational efficiencies.

Further, we can distinguish between use cases that we, as banks, can influence ourselves and try to lead the market, while there are also cases where we need other parties along the value chain (including regulators and central banks) on board. So in this area we need to look for use cases that are, at the moment, very costly, have a high tendency to fail or are highly complex (like international payments with the many correspondent relationships) and that have the potential to be scoped in such a way that banks can actually have an influence or solve the issue themselves. These use cases might be feasible in the short term.

Finally, we are looking for what brings the highest value to solve first, whether that is by cutting costs, increasing simplicity or creating whole new business opportunities. One reason why payments will not be the first area that benefits from the blockchain is its relative simplicity, at least in the euro area, where there are well-defined standards and rules under the Single Euro Payments Area (SEPA) regulations and a single regulator in the European Central Bank, creating an environment of trust. The processes are fully straight-through-processing, and the number of parties involved is limited and includes a proficient

central clearing and settlement mechanism. The product offering is mature and on par with client demands, so the advantages of implementing a blockchain are less obvious.

Having said that, the idea of an industry-wide payments and settlement infrastructure based on trust, cryptography and transparency has an immense attraction. Therefore, you see that many banks are working on use cases in this area. Both defining what this ideal end state could be, while at the same time defining what intermediary steps we can already take. To do this, the market has to assess the technological maturity on the one hand and the 'market maturity' on the other. There are, however, many inherent advantages to using blockchain for payments. In general, the technology offers lower transaction and operational costs, increased processing speed, risk reduction, transparency and traceability.

More specifically, in an ideal situation, these are some economic advantages for the Euro payments system, including the following:

- It removes the need for a central clearing mechanism.
- It removes the need for Target 2 settlement if the regulator accepts the blockchain positions as real money and adopts the blockchain as its payment system.
- Banks' liquidity positions are continuously updated and banks and regulators can create automated business rules in the form of smart contracts, leading to more control.
- Full real-time view on all transactions for the regulator instead of aggregated reporting afterwards.
- Potential for a peer-to-peer payments system where the entire four-corner model is on the blockchain.

WIDESPREAD APPLICATIONS OF BLOCKCHAIN TECHNOLOGY IN BANKING

Although there are innovations happening that make trade finance easier, processes still require the documentation of many contractual obligations (escrow) and/or steps to be documented and checked (letter of credit). Much of this complexity can be better managed in a distributed ledger that connects all involved parties and helps automate what needs to happen next in the process. Here, the blockchain offers huge possibilities in automation, transparency and lower costs for both the bank and the client.

Settlements are likely to be one of the main applications, with Masters suggesting that settlement times for products such as syndicated loans could be shortened from around 20 days today to just 10 minutes, reducing risk and freeing up capital.

Trade finance is another area where the technology could disrupt the industry. According to Anju Patwardhan, Group Chief Innovation Officer at Standard Chartered: '[Trade finance] has traditionally been a paper-intensive process but it is possible to use blockchain technology to digitise and authenticate records. This can result in trade transactions that are secure with digital records of related data visible to various participants in the trade transaction.'[8] The technology could shake up one of the most conservative parts of the industry if banks and companies seize the initiative.

On top of that, due to the highly paper-based process, compliance is an important issue. The blockchain— and more specifically smart contracts—can enable compliance to be enforced upfront instead of being verified after the transaction. And when auditors or regulators are part of this blockchain, reporting becomes completely transparent and real-time. This presents advantages for regulators as well.

When technology is combined with the development of the Internet of Things, its potential is increased even further. For example, a container arriving at a port could be scanned and provide the trigger for the shipping company to be paid and ownership of the container transferred, as part of a smart contract agreed in advance.

Meanwhile, in securities transactions, post-trade clearing and settlement is slow and expensive, involving many actors including global and local/sub-custodians, central counterparties (CCPs) and central securities depositories (CSDs). Settlement of a securities transaction typically takes two days, often longer, to complete. And then there is even the risk of a failed settlement at the last moment. This presents a big risk and even costs to all parties involved. Blockchain and the distributed ledger have the ability to securely and transparently move securities in seconds or minutes, with automatic clearing and settlement upon trade execution.

Any area where there is plenty of paperwork across industries offers potential for the blockchain to improve operations.

'When confronted with complex value chains we were able to implement solutions by either centralising (like with faster payments in the UK) or standardising (like SWIFT), but when confronted with other industries we still relied a lot on paper. Blockchain might have big potential there,' says Simon Taylor, VP Blockchain R&D, Barclays.

Revisiting the general benefits of blockchain technology mentioned at the start of this paper, we can identify many aspects within banking that would apply, ranging from payments to lending, from trade finance to security trading and settlement, from KYC/ CDD (know your customer/Customer Due Diligence) processes to internal accounting. The most important thing to do is to find those cases where it makes sense the most, where we actually have a real problem to solve and the ability to solve it.

BARRIERS TO ADOPTION

Besides finding the best use cases to start with and finding out where blockchain can bring real value, there are still some technical issues that need to be solved before we can apply blockchains on a large scale.

First of all, before wide adoption of blockchain in, for example, international payments, issues of scalability and privacy need to be addressed. This is easier said than done because no single legal framework that covers the full spectrum of blockchain technology exists. On top of that, there are differences between jurisdictions around the world, increasing the difficulty of applying the correct laws and regulations. New frameworks must develop around privacy, right of claim and consumer rights.

The industry needs to thoroughly analyse privacy and data protection risks and incorporate them in the implementation of any blockchain use cases. E-identity validation services will be crucial to facilitate the spread of blockchain solutions, and here banks can play a significant role as banks are still seen as organisations that can be trusted.

Scalability and latency limits must be addressed to ensure high-volume applications of block chain technology such as payments. For payments, discussions around settlement finality and thus the acceptance of assets on distributed ledgers by central banks and regulators is fundamental to large-scale adoption. On top of that, blockchain is not always the best or cheapest solution available and while it will take significant time to gain large-scale adoption within in the industry, it could mean that we have to run two infrastructures in parallel. Total cost of ownership (TCO) is an important factor to take into account as well.

NEXT STEPS

While opportunities are as plentiful as the questions still to be answered, ING and its peers want to be part of this development and future solutions for the financial industry. To this end, there is a lot of research and experimentation going on, a variety of networks have been created and individual banks are collaborating with peers to bring development of blockchain for the financial industry closer, one step at a time.

The main priorities at the moment are as follows:

- To define a strategic framework to identify the real opportunities of blockchain technology across the various business lines of the bank, giving institutions a way to prioritise their efforts while at the same time increasing their knowledge and awareness within the business
- To work on a variety of use cases that have a potential to solve real issues in the short term as well as technical experiments to further test the possibilities of the technology in general.
- To involve main stakeholders both internally (legal, compliance, risk) and externally (regulators, partners, peer banks) to address the 'hard problems' and work towards industry-wide improvements

CONCLUSION

Blockchain has great potential to be a disruptive force in the financial sector. It is already possible to see where it might have an impact, in areas ranging from payments to settlements, to smart contracts and e-identity.

Blockchain technology is based on such different principles that it forces us as a bank and as an industry to rethink the way organisations, processes and markets work. It has the potential to fundamentally change the way we think about ownership, money and risk management. It has been said before, but this development is not about simply 'putting a blockchain on it' to make things more efficient. Blockchain technology is not the solution for everything, which is why the focus is currently on defining where there is real business value. The technology has the ability to make a difference in many layers of the financial industry, if participants work together and carefully design solutions. This requires time, experimentation and concentration. It is expected that short-term focused solutions will slowly grow into more integrated and complex use cases, step-by-step proving the value of this technology.

One thing that is obvious, however, is that this is not a technology that one player can develop in the hope of winning an advantage over rivals. Rather, its application will help the industry as a whole—but only if all participants work together.

This is happening in initiatives such as the R3 consortium and that work has continued in 2016, allowing the industry to move closer to sector-wide standards for blockchain. As Bart Suichies, Technology Lead at Philips Blockchain Lab, wrote at the end of 2015, 'ultimately, like mobile, like the Internet, and like computers before that, blockchain is not the thing. It's the thing that enables the thing.'[9] As such, if it is developed collaboratively, it can help the entire industry and its customers.

References

1. Williams-Grut, O. (2015) 'Santander has '20 to 25 uses' for the technology behind bitcoin', available at: http://uk.businessinsider.com/santander-has-20-25-use-cases-for-bitcoins-blockchain-technology-everyday-banking-2015-6 (accessed 9th August, 2016).
2. Batlin, Alex (2016) "Crypto 2.0 Musings - Privacy and Confidentiality on Blockchain" also available at: https://www.linkedin.com/pulse/crypto-20-musings-privacy-confidentiality-alex-batlin?trk=prof-post (accessed 9th August, 2016).
3. Robinson, E. and Leising, M. (2015) 'Blythe masters tells banks the blockchain changes everything', available at: www.bloomberg.com/news/features/2015-09-01/blythe-masters-tells-banks-the-blockchain-changes-everything (accessed 9th August, 2016).
4. Mckinsey&Company (2015) 'Beyond the hype: Blockchains in capital markets', available at: www.the-blockchain.com/docs/McKinsey%20Blockchains%20in%20Capital%20Markets_2015.pdf (accessed 9th August, 2016).
5. Ibid.
6. Ibid.
7. Ripple (2014) 'The Ripple protocol: A deep dive for finance professionals', available at: https://ripple.com/files/ripple_deep_dive_for_financial_professionals.pdf (accessed 9th August, 2016).
8. Anju Patwardhan (2014) "Blockchain – a disruptive force for good?", available at: https://www.linkedin.com/pulse/blockchain-disruptive-force-good-anju-patwardhan?trk=mp-reader-card (accessed 9th August, 2016).
9. Suichies, Bart (2016) "why blockchain mus die" also available at: https://www.linkedin.com/pulse/why-blockchain-must-die-2016-bart-suichies?trk=prof-post (accessed 9th August, 2016).