Dissertation

Disrupt or be Disrupted – Can blockchain technology revolutionise Irish asset management and what are the implications for trade and settlement and the regulatory outlook?

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MBA Award

National College of Ireland

August 2018

Submitted to National College of Ireland August 2018

Abstract

Disrupt or be disrupted – Can blockchain technology revolutionise asset management and what are the implications for trade and settlement and the regulatory outlook?

Richard Garry

The purpose of this dissertation is to explore the role of blockchain technology as a disruptor for the Irish asset management industry. Specifically, the points of interest are the trade and settlement functions within the operational activities of the Irish asset manager and the impacts on regulation should the incumbent technology be supplanted with blockchain.

Asset management has a strong history of technology adoption. Fintech innovations are key to the evolution of asset management and banking, the usage of real time trading information providers such as Bloomberg, algorithm trading, fully integrated asset management trading systems and high frequency trading (HFT) - disruptive technology is key to their evolution. In addition to these areas, the internet and global connectivity has revolutionised the industry, allowing for a global approach, increasing the number of competitors, products, client access and creating a truly globalised market place. The coupling of this with the increase of active management, greater levels of AUM and increased access to markets, means trading volumes are at historical highs and therefore greater regulatory requirements and trade and settlement needs.

Recent developments in blockchain technology utilising a distributed ledger, has been much-muted as a game changing Fintech application. Much of the literature posits that the technology will benefit all areas of asset management, from back, middle and front office applications. Key areas of influence and potential disruption are Trade and Settlement and Regulation.

This research is justified given the ascendance of blockchain technology within the financial services industry and as a phenomenon of further investigation as a disruptive technology with far reaching impacts within the industry.

Key research findings develop on the opportunities that blockchain technology can create in the Irish asset management industry, specifically, the roles within regulation and the role regulation is currently playing. Trade and settlement efficiencies are examined and the implications and reasoned adoption benefits considered. With key findings being a lack of direction from the Irish regulator and an apparent lack of communication regarding the future landscape around the technology.

Developed is the realisation through research that there is difficulty in alignment, between the current technology and the possible areas of utilisation, efficiencies and cost effectiveness. These assertions are developed and realised, despite the widespread assertions that the technology will be disruptive and will displace the incumbent.

Submission of Thesis and Dissertation

National College of Ireland

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(Thesis/Author Declaration Form)

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Acknowledgements

I would like to acknowledge and thank the following for their help, guidance and assistance throughout the course of my dissertation: -

Dr Deirdre Bane, National College of Ireland, for her invaluable help and guidance.

All the staff and faculty members in National College of Ireland, especially Colette Darcy, for her support on this journey.

My wife Patrea for all her help, love and support and my wonderful children Lauren and Rowan for reminding me why I was doing it.

In memory of my two friends and fellow alumni

Kieran Keyes and Brian O'Callaghan-Westropp

Ar dheis Dé go raibh a n-anamacha

Contents

Appendix I.

Abbreviation and Glossary

- Centralised Counterparty Clearing House (CCP)
- Delivery vs Payment (DVP)
- Single Euro Payments Area (SEPA)
- European Central Bank (ECB)
- Peer-to-Peer (P2P)
- Proof-of-Work (POW)
- Proof of Stake (PoS)
- Proof -of-Concept (PoC)
- Distributed Ledger Technology (DLT)
- Know Your Customer (KYC)
- Anti-Money Laundering (AML)
- Clearing Counter Party (CCP)

Introduction

Research Topic Background and Problem Statement

The objective of this research paper is to explore the phenomenon of blockchain technology in the Irish asset management industry, specifically in the context of application to the areas of trade and settlement and in terms of regulation.

Cermeño (2016) asked the question "How are distributed ledger technologies impacting the regulatory framework?" The conceit of this paper is that dealing with Distributed Ledger Technologies (DLT) will require sea-change in regulatory approach and require a change in skills and knowledge to govern. Primm (2017) questions the usage, the private, public, and consortium DLTs, all of which have varying degrees of privacy and decentralization, is the regulation different? But significantly, he highlights a gap in the literature, what approach is best for innovative asset managers and is the regulator prepared? This demonstrates that there exists a gap in the literature and an existing problem. This research will attempt to redress this from an Irish asset management perspective.

Mori (2016) evaluates the usage of blockchain technology within the parameters of asset management trade and settlement, Jantoń-Drozdowska and Mikołajewicz-Woźniak (2017) consider payment systems, noting the obvious advantages to process, but like the workings of Meiklejohn (2017) they highlight areas of concern, practical and risk elements that need further review and development. The effects of the technology on the incumbent and the application of the new in these areas of trade and settlement and payment are highlighted for further discussion.

Finally, there are other areas surrounding these which are secondary to the interest of the research. The research will also wish to show the further impacts of the adoption of blockchain technology. This paper will consider the changes to the process of trade and settlement and the models used, also the areas of regulation such as KYC applications, which need to developed further due to the knock on-effects and existence around and within the areas of trade and settlement and regulation.

The main problem to be addressed is the area of best application and implication for blockchain technology within the Irish Asset management Industry. This research posits that there is a need for further research in the area of trade and settlement and regulatory aspects and their related processes within the Irish asset management industry.

The next section will develop the area of blockchain technology and why its potential application is so important and therefore warranting further discussion and research.

Importance of Blockchain and Asset Management

"In the future, all public services will use blockchain technology. Blockchain is a great opportunity for Europe and Member States to rethink their information systems, to promote user trust and the protection of personal data, to help create new business opportunities and to establish new areas of leadership, benefiting citizens, public services and companies. The Partnership launched today enables Member States to work together with the European Commission to turn the enormous potential of blockchain technology into better services for citizens". These are the words of the European Commissioner for Digital Economy and Society, Mariyah Gabriel (*Ireland joins European Blockchain Partnership*, 2018).

With the collaboration around blockchain, the 22 nations will be able to more closely share data, and define new models for governance, consent and rights. To support this the European Commission has also created the EU Blockchain Observatory and Forum and has invested over €80 million in blockchain and has set aside more than €300 million in investment by 2020. (Buchanan and Naqvi, 2018)

These quotes reflect the view of the European Union (European countries join Blockchain Partnership | Digital Single Market, 2018), the key element being the commitment of the EU and the 22 nations signed up to the proposal. This commitment reflects and supports the view that the technology will be a disrupter and play a key role across a multitude of industries globally, and in this case the European Union.

The works of Varghese et al. (2017) globally surveyed 1,520 executives from 578 financial services firms, regarding how they envisage blockchain technology impacting their industry. The quick take from their analysis is that the senior executives and managers are expectant of varying levels of fundamental change to the structure of the industry.

"In our study, 91% of respondents said they believe blockchain will be either critical or important to their firm's future, while 48% said it will fundamentally transform the industry. Roughly half of respondents reported that their firm has 11 or more professionals on their blockchain team" (Varghese et al., 2017)

The two stated views above show the real and definite concern, interest and opportunity, ascribed and sought at both supranational level and industry level in blockchain technology and financial services. Academic workings of Primm (Primm, 2017) are interested in the application of regulation and impacts the technology has on regulation. He concludes that more research is required to determine what substantive regulation is best suited for both risk and innovation.

It is these areas combined, from academic, industry and government relaying the belief that the technology is going to be of major import. However, literature such as Pilkington, (2017) air caution, that the technology is deemed to be potentially

disruptive, yet not without risk, that this research deems it worthy of further analysis. The areas of trade and settlement and regulation are pertinent as they are areas this researcher is involved in professionally and are as much of the literature will demonstrate key areas of disruption and worthy of further analysis.

Summary

This paper develops the current industry, the literature, methodology, appraisal and findings surrounding the area of blockchain technology and the Irish asset management industry and gain a further understanding and establish learnings and outcomes attributed to the research.

Overview of Asset Management and Blockchain

The Irish Asset Management Industry

A short high-level overview of the existing Irish asset management and financial services industry is provided to give context for the sector within the Irish economy. The area shall be further investigated and reviewed in the literature review.

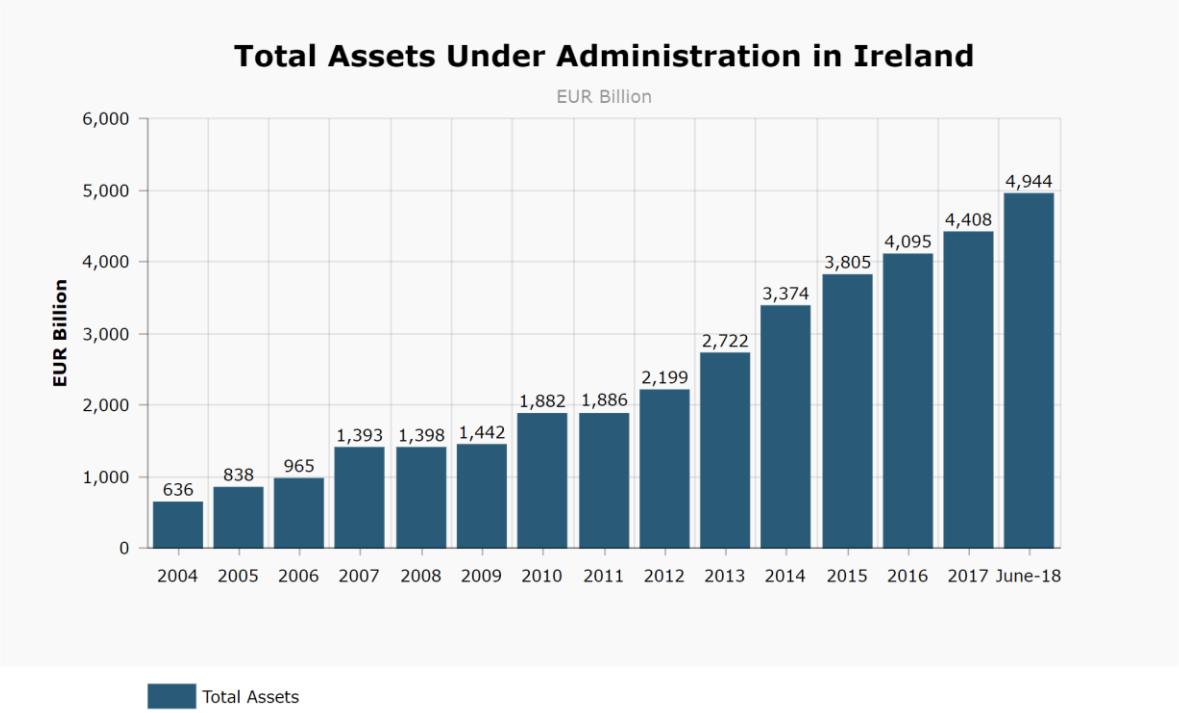

Fig 1. Total AUM domiciled in Ireland (*Irish Domiciled Funds | Irish Funds*, 2018)

The Irish asset management industry, as of June 2018 represents almost 5 trillion Euro under management across over 7,000 funds (Irish Domiciled Funds | Irish Funds, 2018). The number Asset Management companies represented in Ireland is over 130. The Irish asset management industry is expected to manage €7 trillion by 2025 with the global AUM expected to double from the current level to €125 trillion by this same stage (PWC cited in Slattery, 2017) The Irish financial services sector

employs over 35,000 people and contributes €2 billion per year in taxes to the Irish exchequer (IDA, 2018).

The industry is currently expanding and growing benefitting from the post financial crises of 2008 bull market, which has seen asset value inflation and economic growth that is verging on the longest running bull market in history (This bull market could become the longest in history this month, 2018) paralleling the growth and access in emerging markets.

One of the biggest obstacles and industry disrupter in recent times has been the introduction of the regulatory framework Mifid II (i) as of 3rd January 2018 (*MiFID II*, 2018). The aim of which has been to ensure greater transparency, surveillance on trading, reduction in dark pool usage and changes to the research consumption models currently used, as a direct reaction to the 2008 financial crises (Financial Times, 2017)

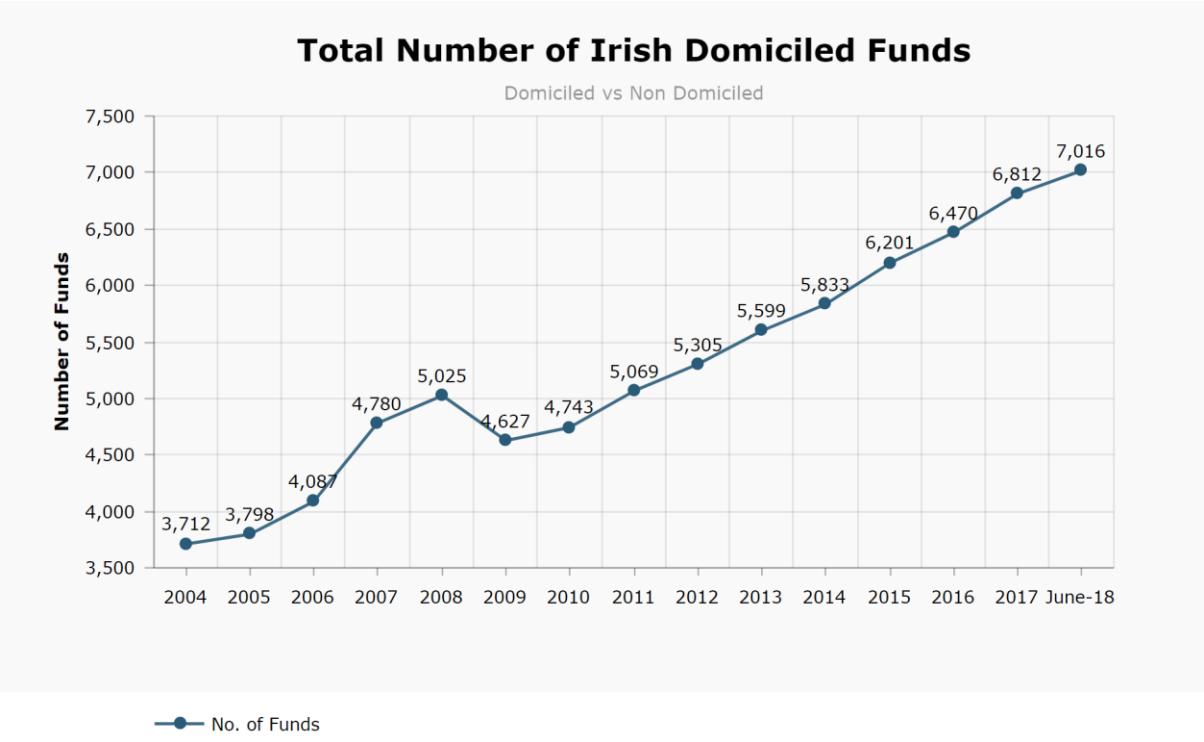

Fig 2: Number of Funds domiciled in Ireland (*Irish Domiciled Funds | Irish Funds*, 2018)

Next the research shall concentrate on the blockchain technology and its potential position within asset management processes.

What is blockchain technology

"A blockchain is essentially a distributed database of records or public ledger of all transactions or digital events that have been executed and shared among participating parties. Each transaction in the public ledger is verified by consensus of a majority of the participants in the system. And, once entered, information can never be erased. The blockchain contains a certain and verifiable record of every single transaction ever made. "(Crosby *et al.*, 2015)

Some of the key features of the technology are:

- ***Distributed Ledger Technology = Blockchain - Bitcoin***
  - Provides a useful generic way to describe the blockchain without bitcoin.
  - Distributed Ledger Technology (DLT) has a tremendous potential for financial services.
  - Its core feature, a distributed ledger, along with
  - Smart contracts
    - Automation and
    - Existing inefficiencies due to the need to reconcile heterogeneous data among participants.
- **Smart contracts**
  - Blockchains were originally created to store simple data (e.g. bitcoin transaction data).
  - "A pays B" type.
  - The idea behind smart contracts is that, in addition to manipulating data
  - `the distributed ledger could also contain code that would autonomously perform certain actions under certain pre-defined conditions, called oracles or triggers (when the conditions are events).
  - Putting it another way, smart contracts allow to share behaviors over the distributed ledger, not only data.

Distributed ledger technology (DLT) is defined as is a digital system for recording the transaction of assets in which the transactions and their details are recorded in

multiple places at the same time. Unlike traditional databases, distributed ledgers have no central data store or administration functionality.

Having provided some basic data and information on the fundamentals of the technology, the paper will next review its application within finance.

Distributed ledger technology in Finance

The technology is deemed to be have multifaceted applications. The key element is however, that it will be used to replace traditional databases, and rather than interconnectivity of systems, through various interpretations and system interactions, the key areas of operational activity will instead utilise the distributed centralised ledger. This approach is illustrated below, where the centralised nature of the technology within the asset management system architecture and the spoke like orbit of the asset management processes is evident. In this case, a "key" of the type of process is utilised beside the illustration.

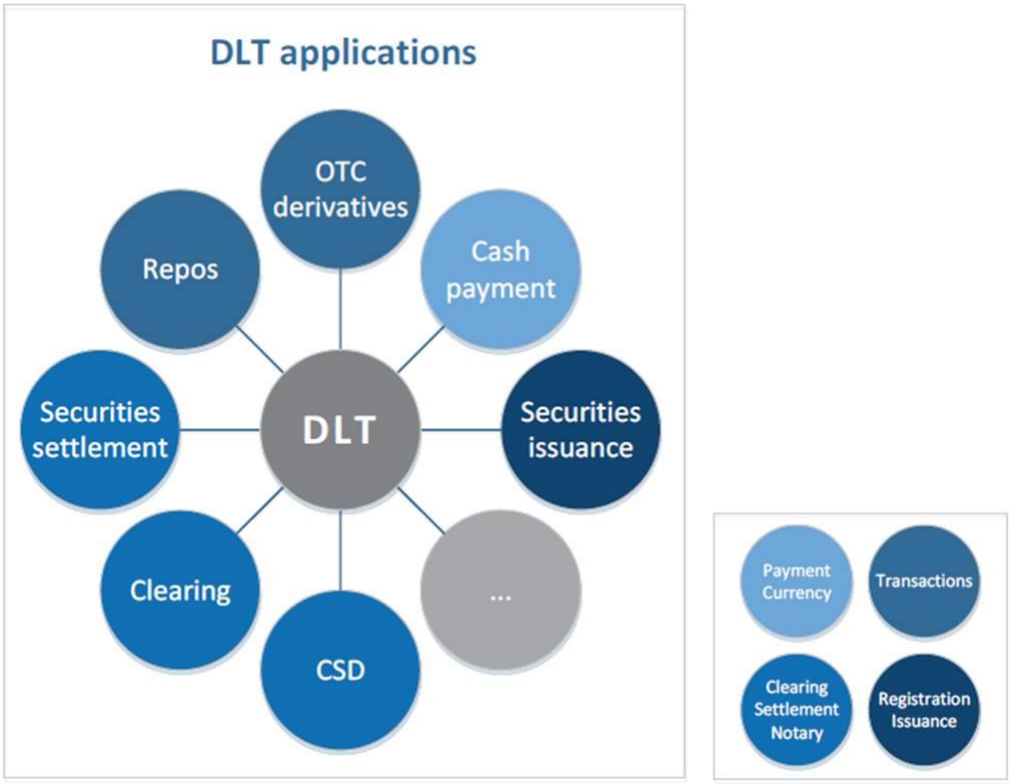

Fig. 3: Illustration of the Spoke idea of DLT in Asset Management (Authors own collection, 2018)

In terms of trade and settlement, the below illustration denotes the change in model. The graphic illustrates the streamlining of the process, removing the steps, such as match/confirm and Delivery vs Payment (DVP). The technology has the capabilities to be incorporated at all levels of the trade process. Trade Order

initiation and execution or delivery Risk management and order routing, Order matching and conversion into trade, Affirmation and confirmation and Clearing and Settlement.

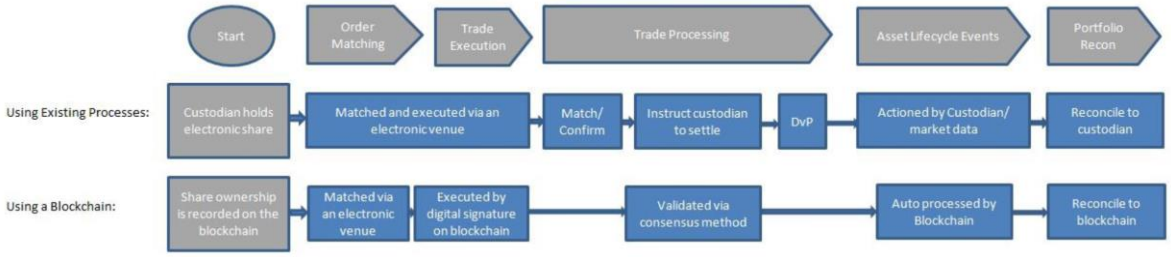

Fig 4:Illustration of the Trade & Settlement Cycle (*Mahajan,* 2018)

In terms of regulation, currently details are shared with the regulator, by various means, FTP files, excel documents, copied documents etc. In all cases, the data is provided directly by the financial institution, often on a daily or weekly basis. Further to this the maintaining of regulatory standards, is administered by the likes of legal and compliance departments, utilising internal rules, restrictions, data storing and reporting by various departments within the institute. Examples of which are legal, compliance and client reporting. The technology may transform these processes by utilising the technology in recording and storing information, aggregating data, sharing of information and ensuring data integrity (Stark, 2017).

From a holistic asset management point of view, the below illustrates the key areas of asset management, from front, middle and back office.

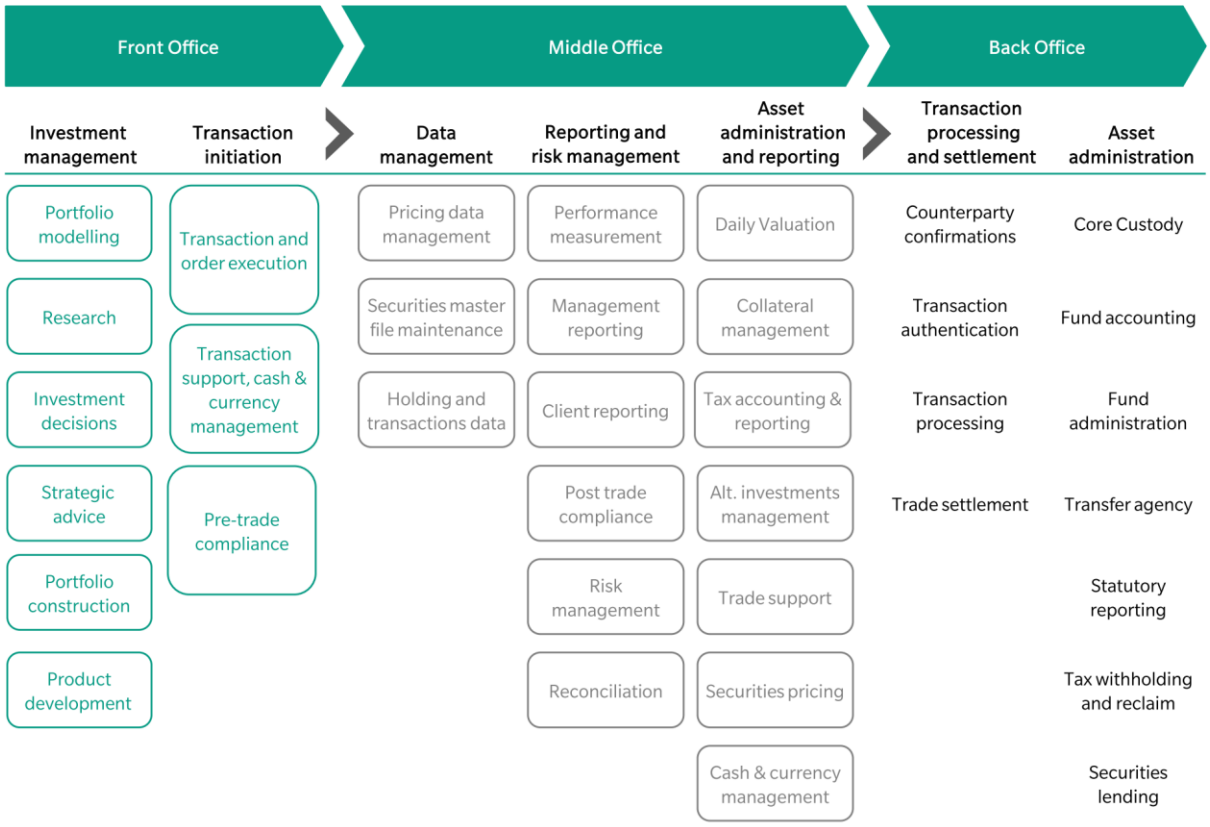

Fig. 5: An over view of Asset Management and Processes (Wyman, 2015)

It is the contention that should blockchain become ubiquitous within the industry, that all areas of the asset management industry will operate using DLT as the base technology for operations (Deloitte, 2017).

This author will now provide an analysis of disruptive innovation, which blockchain technology is considered to be.

Technology and Disruptive Innovation

Christensen (2016) noted that a disruptive technology was one that often was quite straightforward in its makeup but its approach was different, offering something to customers outside of the normal arena's. Blockchain it may be argued, is such a technology, in fact, it may have passed the disruptive stage into emerging, as the areas of crypto-currencies and private DLT's become more common.

The technology is, is believed to have the same disruptive capabilities as the internet has done for how we consume media, within the media publishing industry, but in the context of banking and finance (Ito, 2017).

The next section will examine and review the literature currently available on the topic.

Literature Review

The literature stems across many aspects of blockchain and finance. There are various articles considering the technology and its applications within the asset management industry. In the case of this paper we are primarily concerned the academic and industry articles surrounding the areas of trade and settlement and the regulatory environment. Considering, as part of the implications of the blockchain technology on these specific areas, this paper will also look at the other aspects of the asset management industry interdependently affected by the technology as areas as a secondary research question; it is pertinent and relevant to this paper, to also review that literature which is related to the secondary. This shall be reviewed in the following "Introduction" segment.

Introduction

This section of the literature review will identify areas outside the specific areas or trade and settlement and regulation. To understand the role of blockchain technology in the Irish asset management industry this section aims to provide a discussion of the holistic environment of asset management that these two areas sit within and interdepend on. Why the application of the technology is considered so important within the industry and as an academic topic for research? This section will consider reasons for adoption, such as cost efficiencies, the removal of intermediaries, aligned standards and interoperability, as well as considering the obstacles of adoption, such as technological ability, regulatory obstacles and lack of consensus.

Much of the current literature on blockchain in the banking and finance areas has an eye on the future. The general contention is that the technology is going to replace the incumbent model (Guo and Liang, 2016). The incumbent model being; the creation, holding and querying of data for trading, asset management, regulation and compliance as well as all of the off-shoot requirements using separated databases and systems operating in networks independently or being connected via independent or institutionally operated databases or full suite trading systems. Specific areas of interest are the financial activities such as payments and settlements and the achievable cost efficiencies, of moving to blockchain technology. Other areas of interest are the regulation, implementation, and barriers to entry associated with the adoption and application of the technology. Meiklejohn (2017) Identified the key areas that obstacles to DLT adoption: usability, governance, comparison, key management, agility, interoperability, scalability, cost-effectiveness and privacy. The areas of governance, usability and scalability are relevant towards this research. Here the author Meiklejohn (2017) has considered the problems currently faced and provided a recommendations and advisories regarding the adoption and possible improvements that would be evident from the application. The

contention being based on her research that DLT technology can circumvent and develop the existing process and improve the incumbent model. This research is of interest to this paper, the adoption of the technology is relevant and the as well as considerations around the benefits from its application.

This research examines Distributed Ledger Technology and the potential benefits it might afford to the Irish Asset Management industry. The areas to be reviewed in this research are the applications of DLT in asset management and its effects specifically operations focusing on trade and settlement and regulation with a focus on Irish asset management and within the European umbrella. These subjects warrant research and consideration as the Irish asset management industry currently represents 4 trillion USD under management within Ireland and the expected global assets under management figure to grow to 125 trillion USD by 2025 (PWC, 2018). The pervasive nature of asset management; from its direct effect on employees, clients and financial institutions and sovereign entities, as well as the secondary implications for the invested parties and floated and private companies, to the tertiary service providers, mean for all encompassing impacts. Deloitte, (2017) identified the value chain impact of blockchain, illustrating the mass application and the degree of influence and application the technology can have within asset management, office rental and cleaners mean that should there be a potential disruption to the industry leading to 50% potential cost savings on centralized operations and a potential 70% savings in the regulatory areas (Accenture, 2016) as well as a fundamental change to the operating model, this paper believes this is a key argument for further research.

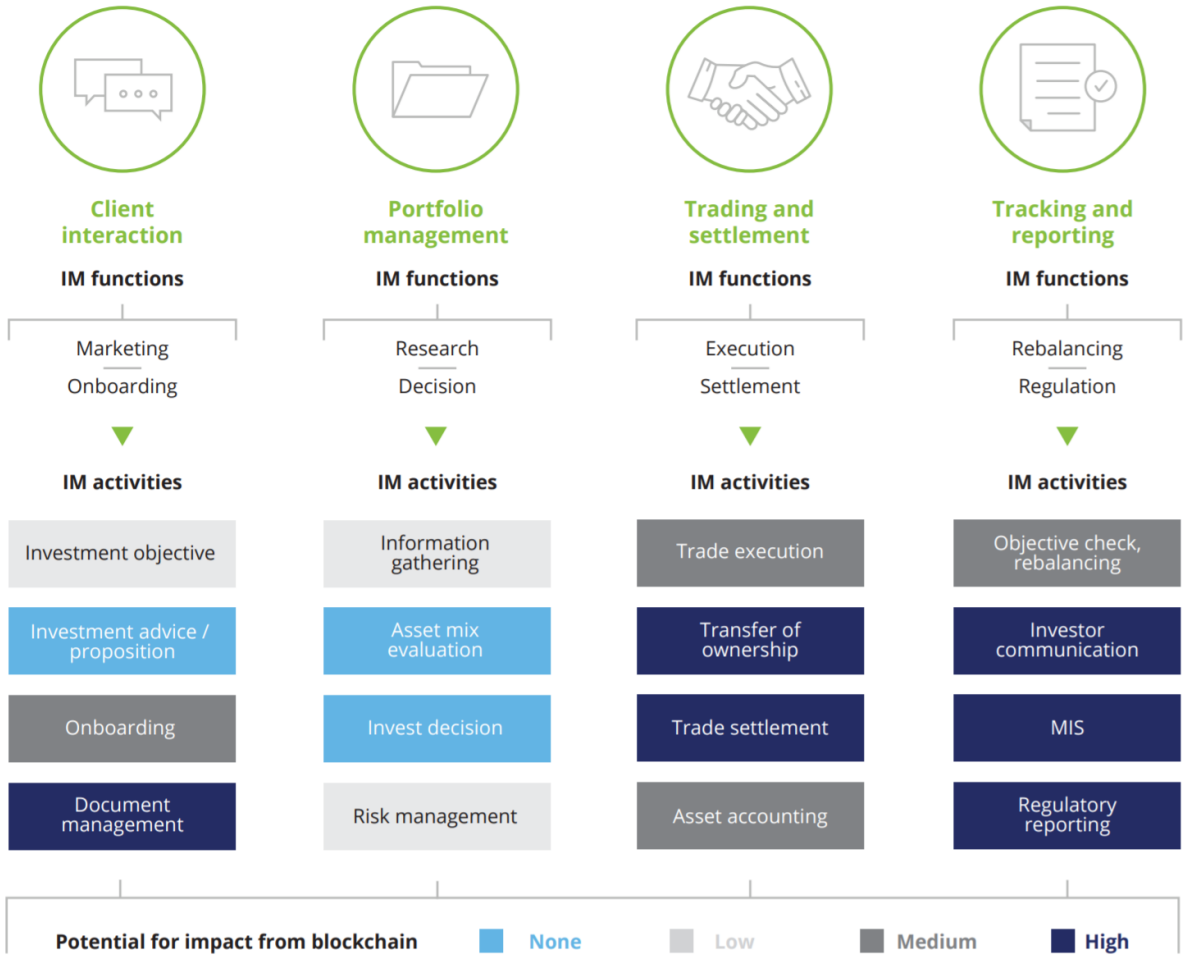

Fig 6:Value Chain Impact from Blockchain Source: (*Investment management firms getting started with blockchain*, 2017)

It is important to recognise that most studies acknowledge that there will be large cost savings by the adoption of blockchain technology in the asset management industry (Friedlmaier, Tumasjan and Welpe, 2016). The asset management industries traditional foundation of asset ownership and asset transfer are often inefficient, expensive and vulnerable. Cocco, Pinna and Marchesi (2017) discuss blockchain technology and its transformative impact on asset management and financial institutions, specifically areas of financial services activities to which blockchain technologies would bring efficiencies. These include trade finance for payments, securities settlement, regulatory compliance, foreign exchange as well as a sea change in existing networks, information collation, as well as messaging and IT systems. Cocco et al (2017) provide insight into some of the key limitations of blockchain technology, specifically should the Bitcoin model be applied; these are the low number of transactions per block and the excessively high computational power that it currently needs. Their work views these issues as being potential obstacles, however, should they be overcome the financial infrastructure as we know it, will see efficiencies in all facets of the industry. Their work provides a current

cost-benefits framework based on a quantitative analysis. Thus, providing a basic insight into the future efficiencies and the research derives a conclusion of where improvements in the technology are required for it to be viable. Supporting literature on the industry such as Singh (2016), and grey literature such as Accenture (2017) estimate possible 30% savings made on settlement trading, (*Santander*, 2017) providing further details on potential savings of 50% on centralized operations and a potential 70% savings in the regulatory areas. The potential savings are apparent from the literature, and deserve further development in the context of the Irish asset management industry and whether they are deemed as achievable. Further empirical evidence is provided in the following literature.

Date	Simulation Step	Average of Hash Rate $\frac{GH}{s*\$}$	Average of Power Consumption $\frac{W}{GH/s}$
1 September 2010	1	0.0017	454.87
29 September 2011	394	0.0014	19.8
2 December 2011	458	0.00175	34.4
28 December 2011	484	0.0017	72.575
1 May 2012	608	0.0029	72.575
17 December 2012	835	0.03565	1
10 April 2013	953	0.0194	6
31 May 2013	1004	0.0201	6
15 October 2013	1141	0.1351	3.84
10 December 2013	1197	0.0595	3.84
22 January 2014	1240	0.245	2
4 July 2014	1403	0.583	1.1
23 October 2014	1513	1.6	0.69
30 August 2015	1824	2.756	0.51
1 December 2015	1918	2.666	0.249
1 May 2016	2070	4.746	0.273
30 September 2016	2221	8.465	0.099

Fig. 7: Economic efficiency expressed in Hash rate vs power consumption from September 1 2010 to 31 December 2016 Source: (Cocco, Pinna and Marchesi, 2017)

Works such as Caytas (2017) investigate current technology uses for real-time clearing and settlement and how through the development, adoption and implementation of DLT the process, in theory, will reduce counterparty risk, reduce the time between trade placement and settlement and ensure a transparent and incorruptible ledger entry and legal contract for the transaction. The focus is using blockchain for clearing and settlement. Financial institutions see the technology as a means of establishing real-time trade and settlement. The data blocs would contain the entire history of the trade, payments made for securities, goods or other assets. This then allows buyers to recognise the asset through the parameters of registration and identification within the fintech system in place. The result being confidence and security in provenance and title is greatly increased. This information regarding the new owner is then encrypted and inaccessible to any party not authorised to access it. The intrinsic validation of the blockchain created transaction, i.e. Existing copies are created and validated across the world on various computers connected via the internet (or Nodes), adds a significant security element,

prohibiting forgery and manipulation as well as preventing illicit sales of assets to more than one party.

Further analysis by Mcmyn and Sim (2017) attempted answer the question "Is a single global network or are multiple business networks the right structure for a distributed ledger ecosystem for trade finance?" Their research is relevant to this research paper as they weighed up the trade-offs between a single and universal global network versus multiple business networks. Their conclusions that critical area of interoperability between different business networks would be achievable through the adoption of global technical standards, means that a key obstacle is in the opinion of the authors attainable. However, an area of key interest to this paper is the area of regulation, which Mcmyn and Sim, (2017) believe that without a global consensus on common law and regulation a global consensus will be far more difficult to implement. However, in the context of Irish asset management, gains in interoperability and regulatory consensus can be achievable through the management of regulation in a European aligned manner (Atzori, 2017).

These assertions require further review. The application and current systems and their ability to counter move need further exploration as to whether blockchain will be the future technology for asset management companies.

While the applications are vast, this paper is primarily concerned with the areas of trade and settlement, compliance and regulation. Specifically, this paper will focus on how the change to trade and settlement will potentially change the currently utilised traditional models in the asset management industry as regards to trading. Regarding regulation, the area of Know your Client (KYC) and Anti-Money-Laundering (AML) are of interest, which inherently feeds back to the financial reporting functionality and regulatory authority. In this case the Irish Central Bank and under the auspices of the European Union's financial regulations.

The evidence presented in this section has shown that the general area of DLT and its implication for Irish asset management is an area that requires further analysis. The industry interest in the area as well as the academic research currently available provide evidence of technology and industry at the cusp of disruption, requiring further insight and analysis. The next section will concentrate on the areas of operations, specifically trade and settlement and the DLT applications. Following on from this, this research paper will investigate the literature surrounding regulation, with an onus on KYC and the Irish asset management industry.

Trade and Settlement

This section will examine the literature in the area of trade and settlement, looking at trade, settlement and payments and the trade and settlement models.

Trade and Settlement and Payments

The paper will now concentrate on the literature surrounding trade and settlement. This is a subject that will be demonstrated through the literature is considered very susceptible to the disruptive nature of a blockchain model. Should we consider payments systems and the impact blockchain will have, Jantoń-Drozdowska and Mikołajewicz-Woźniak, (2017) looked at the European single payments system, SEPA (Single Euro Payments Area) which has been in place since 2008 and utilised by 28 European states (SEPA, 2016) The research of Jantoń-Drozdowska and Mikołajewicz-Woźniak (2017) centred on the aims and failings of SEPA which aimed to consolidate credit transfers, instant credit transfers, Direct Debit and Business to Business payments under a harmonised rulebook and management system. The authors analysed the European Central Bank (ECB) payments statistics using comparable data for SEPA and non-SEPA transfers to provide a quantitative analysis, as well as a qualitative based approach to the counter point of DLT based payments, due to the lack of adoption. The contention of the authors being the SEPA payments model has not fulfilled key objectives which could be fulfilled by a cryptocurrency model. The specific failings being realtime payments, outside member state payments and currency exchanged transfer. The incumbent model within Europe is SEPA, for international transfer SWIFT payments are used, the largest international payments provider (SWIFT, 2018) and there are a variety of cryptocurrencies available such as Bitcoin (Pagliery, 2014).

Further review of the literature in this area reveals comparisons on the advantages using these 3 payments systems, for example, SEPA restricted to member states, the high transfer cost and relatively slow transfer of payment via Swift and the volatility of Bitcoin (Coutts, 2017). Further development of the area of SEPA payments (Van der Valk and Senechal, 2018) analysis the impacts of SEPA's instant payments scheme (SCTINST) with a 24/7 capability. The capabilities of this method of payment, instant payment and 24hr processing, seem to displace the failings of SEPA in comparison to a DLT based payment system highlighted (Canaday, 2017). Grey literature such as Santander Innoventures (Santander, 2017) claim that by 2022 banks could be saving $20 billion annually as a result of savings in settlement, cross-border payments and regulatory costs. McKinsey consultants (McKinsey, 2016) estimate banks may reduce operational costs by USD 1.6-2.1 billion annually, with the incorporation of DLT, and further increase of income due to transaction efficiencies of the overall trade chain. The headline savings figures are convincing however further investigation is required. The literature reveals gaps in the areas of payment types, whether a DLT/Crypto currency-based approach is desirable in the light of developments by SEPA of its technology, or whether the advantages and

savings of cryptocurrencies are apparent when the market shows such volatility . Should a crypto like Bitcoin be adopted, is the interoperability present and is the incentive there to change model?

In research critiqued various forms of blockchain technology versus the standard foreign exchange trade and settlement system (Neyer and Geva, 2017). This paper evaluated Ripple and found benefits in reducing processing costs, transfer speeds and the ability to operate cross-currency, within the FIAT[ii] currency group. They found savings of 33% on existing operations, figures supported by industry consultants Accenture (Accenture, 2017). However, the study takes the view that current level of blockchain technology does not surpass the existing systems. They assert that until there are widespread adoption and maturation of the blockchain technology into a cost-effective and legally robust mechanism, the technology will not be wholly adopted. Instead of allowing for incumbents like SWIFT (GPI, cloud-based system) to upgrade their technology and operating model to compete.

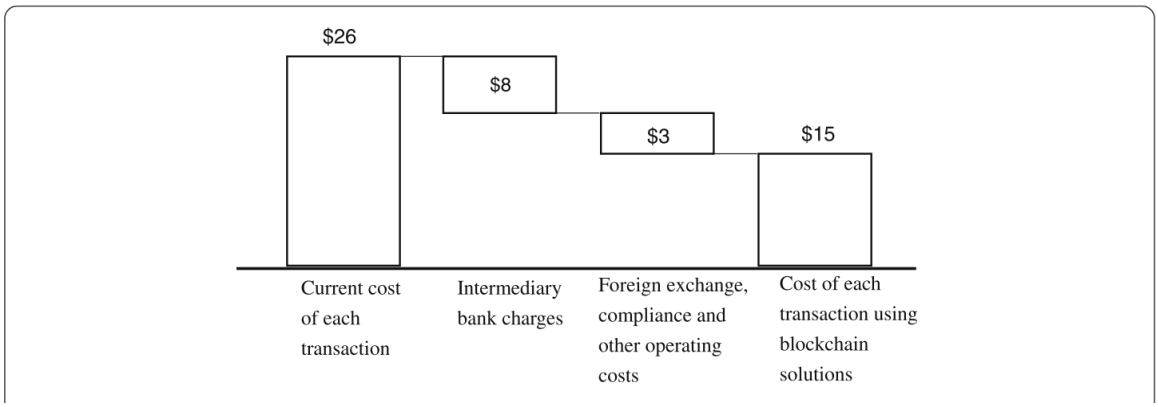

Fig. 8: Application of Blockchain in Cross-Border Payments (McKinsey, 2016)

This is a an area that may be developed, as the subsequent literature does not see issues surrounding the actual capabilities of the technology, but rather the general obstacles financial innovation; technical and regulatory, as being ones that will always be met and invariably, resolved. (Guo and Liang, 2016)

These are areas where this paper will attempt to develop understanding and insight are the capabilities apparent and applicable in the Irish asset management industry? This leads us to our next area of literary review, the models used and surrounding payments, trade and settlement models, questioning whether SEPA and SWIFT can be replaced and why it could or won't happen?

Trade and Settlement models

To understand the role DLT in the payments and settlement areas, this essay will review the models surrounding the area and the impacts of the technology adoption, next we will considerer Delivery versus payment (DVP), Over the Counter (OTC)

trading and whether distributed ledger technology will supplant it. Such issues are discussed by Neyer and Geva (2017), specifically settlement finality, - the legally defined moment of transfer of an asset or financial instrument. DLT may not have the processing power or block size level currently in order to process quickly. This issue would be fatal in terms of asset transfer and asset management trading operations. Furthermore, the models of DVP (delivery versus payment) and OTC (over the counter) add more complexity to any future model. A more recent study, however, discusses how the DTCC (Depository Trust & Clearing Corporation) is preparing to go live in late 2018 with their own blockchain network, which will see them handling $11 trillion of credit default swaps on the system (Nordrum, 2017). Both DVP and OTC trading require a trade and settlement process, requiring match and confirm, custodian input and DVP (the payment and asset delivery. As illustrated in Fig. 4), the blockchain model removes key elements of this chain and allows for almost instantaneous match, payment and transfer.

The literature surrounding trade and settlement generally agrees on the potential savings that a distributed ledger technology format could achieve, this paper will question this in terms of an Irish asset management frame and in context of this papers research. However, there is potential for further investigation into trading and settlement, how the technology will overcome the current shortfalls and whether asset management companies are willing to invest in it in its current form.

The Role of Clearing Counterparties and Intermediaries

However, if we look at the various industry consortium led white papers, one can gain a greater understanding of the current industry standards and the future industry changes. One paper which considers the specific area of derivative clearing and settlement, Platt, Csoka and Morini (2017) examine the history and reasons for central clearing, as means to negate risk of default for bilateral trading where delivery of goods and payment were not immediately deliverable. This form of guarantee was updated for derivatives, whereby the Chicago Board of Exchange (CBOT) introduced a new system of clearing houses created a list of approved members, whom opened their books for risk inspection. Further developments in the 20th century saw the introduction of variation margin as a means of reducing counterparty risk. Finally, the clearing system was applied at the behest of regulators and exchanges for non-derivative products, bonds, equities etc. utilised the system to negate risk.

Examined in their paper are the challenges of modern clearing, collateral costs, reliance on accurate reporting, multiple Centralised Counterparty Clearing House (CCP) members and multiple clearing members for investor clients. The opportunities for clearing to benefit from distributed ledger technology are also examined, of particular interest to my research are contract settlement and payments. The paper sees this area as being particularly suited to on-ledger

activities, with contract settlement being done on a DLT allowing for easy access and analytics in near real time, for counterparties and brokers as well as more effective risk management and error reduction. Payments for example in the form of variation margins, could conceivably be far more direct would allow for a decrease in the numbers by incorporating bi-lateral netting and collateral movements. These operational functions are cleared derivatives market are obvious improvements that DLT can provide, however, the question still prevails whether there will be in fact usage of clearers in the non-derivative markets, such as currently used in equity and bond trading and whether in fact the disruption in the technology will enhance the CCP and counterparty's position or erode it as a key participant in the trading lifecycle.

Walker (2017), examines the current inefficiencies of the trade cycle. The research clearly identifies the mechanisms causing problems in the trade life cycle processing and the techniques that could be used to address them. The areas of concern being issues with quality and completeness, failure for connection to all relevant systems, manual error, translation issues, bespoke processes, significant amount of manually booked trades, paper trails and mutating systems or messaging formats. Much of the literature expands on a view that a centralised system which can deal with basic drivers of complexity, supports the mutualisation of non-differentiating processing between banks, able to work with analytic software's and can simplify settlement which can meet these requirements, the views of Guo and Liang (2016) states;

"Blockchains could revolutionize the underlying technology of the payment clearing and credit information systems in banks, thus upgrading and transforming them. Block- chain applications also promote the formation of "multi-center, weakly intermediated" scenarios, which will enhance the efficiency of the banking industry"

To achieve this solution Walker (2017) contends that DLT is the solution. He develops models to demonstrate the efficiencies of a centralised system, real time sharing of data with immutable data capture. In this case the Corda DLT platform is used to test their contentions. In the paper, the adoption of a hybrid model whereby existing technologies are used to upload the data (e.g. Trading software) to the DLT. Thus, allowing the new and old technology to be used in tandem and realistic understanding of real world data applied, to allow for the key benefits of DLT in trade processing to be harnessed while being relatively undisruptive. This is an area that can be developed in my research. While there are theoretically advantages to the trade lifecycle processes as a whole, what are the direct changes we will see for trade and settlement? Are they apparent always, and do they require other elements to be in place and if so, does this mean complete disruption rather than the hybrid gradual change seen here, using the hybrid model.

At this point this essay will review the hybridised model and its role, and area that will be built upon in my research as part of the questions surrounding adoption and incumbent model replacement. The research adds to the ideas hybridisation to total disruption. The incumbent model being totally replaced and new variants the norm, this is an area that will be further developed in my research. Zhao *et al.*,(2018) consider the effects on settlement in an inter-bank relationship. The authors look at the current settlement models available to the banking system and apply 3 new models, all of which utilise an intermediate cryptocurrency and DLT (a cryptocurrency which is not publicly available like Bitcoin, but solely functions in the interbank market, solely accessible by financial institutions) 3 models using a trusted third party were also investigated. Through application and analysis of these models the authors were able to conclude that the facility for decentralized international transfer of money market institutions is conceivable and especially relevant in the context of this paper is their assertion that a centralised third party may not be necessary for automated fully funded co-ordinated payments.

Following on from the questions directly on the adoption of the technology for trade and settlement, the literature suggests the area of clearing and counterparties is directly related to the principles and research on trade and settlement. It is with this in mind and following the consumption of the literature that this is a pertinent and very much a contentious area, warranting further investigation. While literature such as Kakavand *et al.* (2017), view the holistic impact of the blockchain and asset management, they also contend that the technology could mean the end of centralised clearing and the displacement of the incumbent model of payments, specifically the removal of intermediaries such as brokers, should peer-to-peer trading be the standard and the perhaps in the tokenism of securities where we may see asset managers trade directly with the exchanges (Micheler, 2015).

This section provides an overview of the opportunities DLT might afford to the operational trade and settlements component to Assets Management. As mentioned in this section, SEPA regulation has changed the industry and therefore this section is now followed by the consideration of 'Regulation and Compliance'.

Regulation and compliance

This next section will review the aspects of regulation associated with the current industry norms and more specifically the implications for the adoption of blockchain technology. Any incumbent or potential technological or systematic change to processes of trade and settlement and payments must adhere to the current regulations. In the case of payments there are specific SEPA regulations (*SEPA*, 2016) surrounding the operating, participating and legal frameworks of its application. In terms of Irish and European asset management, all financial

institutions must operate under the strict guidelines of Mifid II (*Central Bank of Ireland*, 2017) With these regulatory frameworks in place this paper will consider the regulation and blockchain adoption.

Regulation is going to prove a major obstacle of the technology. Obvious reasons are the lack of oversight, being a peer-to-peer system. The removal of custodial services, whereby a third party held assets until confirmation of monies received and asset available were satisfied. In addition, reporting requirements and risk analysis, may have regulatory implications (Cermeño, 2016). It is however this very area that fuels the development of the usage of blockchain technology in the areas of anti-money laundering (AML) and know-your-client (KYC) regulatory reporting aspects.

Stark (2017). Identified the application of distributed ledger technology to regulatory and compliance processes. Particularly framing the rise in popularity of "RegTech" as a reaction of financial institutions to comply with the post 2008 financial crisis expansion of global financial regulation, such as Dodd-Frank[iii], Basel III[iv] and the greater emphasis on KYC (Know Your Client) and AML (Anti-Money Laundering). Firstly, considering application in response to the changed regulatory landscape, Starks work develops and analyses the regulatory process and how the DLT may be mapped to it. The area's being, recording information, as per the requirements of financial regulations such as Mifid II whereby the technology adoption would supplant the requirements under these regulations for the vast amounts of data capture required, albeit still retained, but using the distributed ledger format, eliminating much of the manual updates, onerous double entry elements and removing a requirement for matching. Also reviewed was the use of the technology to aggregate data. The means by which regulations often require data from various jurisdictions, institutions and systems, often incompatible or requiring interpretation. The distributed ledger is viewed as a replacement for the compiling of information from various bodies, instead the information is created and shared with the regulator on the blockchain. Lewis et al(2017) who's workings investigate the use of a DLT and permissioned access conclude that the regulatory imperatives such as Know Your Customer (KYC) and Anti-Money Laundering (AML) for financial applications are preferable on private DLTs, as transactions on a fully public, permissionless blockchain are anonymous and open to all, while private systems can limit participants to those who are pre-approved and trusted. They also see this as the preferable operating model for regulators, who would have direct access to the blockchain to view the data of transactions within the ledger. There is a gap in the literature in this area as to whether the asset managers would prefer to provide information of the chain for the regulator or are happy to provide access. There is also a question as to whether the regulator may enforce access to the blockchain.

"*In the near future, we will see the development of specific applications of DLT that are likely to enable better cooperation between the public sector and private sector*

and improve transparency, trust, information sharing, and audit trails" (Lewis, McPartland and Ranjan, 2017)

This leads to the final area which is data integrity. The use of a single authorised ledger among multiple parties will ensure less errors, as opposed to various entities providing individual records. The key element of immutability and smart contracts allow for a trustless operating model (Lauslahti, Mattila and Seppälä, 2017), whereby the ledger self-governs through its proof of work concepts and immutable nature. This leads to another gap in the literature, while the data maybe irrefutable and proved through the other DLT contributors, how does a mistake get rectified?

Stark (2018) concludes that the DLT is a suitable technology to fulfil many of the basic requirements and processes of regulatory compliance. However, this is quite broad and does not define whether doing so will require changes in the technology or regulatory environment. In the case of the Irish Central bank, is it an area they are interested in and or is it a technology they are willing to accept as a means for Irish based asset managers to deliver their required reporting meet their EMIR[v] or Mifid II requirements and if so is technology robust and capable of doing so in its current state?

De Meijer (2015), discusses the regulatory viewpoint of the UK. Under the helm of then, Chancellor of the Exchequer George Osbourne set out to be a friendly jurisdiction for crypto currencies. Even still, they are requiring anti-money laundering standards to be applied and a means for the Financial Services Agency to monitor and regulate crypto-currency trading through licensing. In terms of Europe, the European banking association since 2016 there have been intentions to apply some regulations but as of September 2017, there is no official crypto currency regulation in place.

The current literature highlights current regulatory issues surrounding smart-contracts, compliance and virtual currencies (Primm, 2017; Kiviat, 2015). In regards to DLT's two major issues highlighted are security and operational risk. An example is their susceptibility to 51 percent this issue is also highlighted by Walsh (2015), where those who control over 50% of the network's mining hash rate, or computing power, and potentially negatively influence the system. Also, systematic risk, the removal of counterparties i.e. regulated intermediaries, will require regulators to adopt a new approach and asset managers will need to contemporaneously re-evaluate rules set by the Securities Exchange Commission (SEC) or by their central banks surrounding settlement finality.

The further research literature on regulatory implications and methods view the topic in terms of an individual country. Review the implications for Canada, work centres around the "sand-box" approach being adopted by the Canadian government (Ducas and Wilner, 2017). Their work provides important understanding into the more

restrictive positions taken by countries such as Russia, Thailand, and China (Umarovich et al., 2017). However, their contention that the innovation pace of blockchain technology in fintech, means that top-down regulation is unfeasible, instead open and collaborative regulatory approaches with the private sector will need to be adopted. This model has already been applied in the UK, "Project Innovative", (de Meijer, 2015), whereby the aim was to provide regulatory guidance for market participants, promote competition and protect consumers. By inviting vetted participants, many of which were international companies, the UK Financial Conduct Authority was able to apply a regulatory rigor, in conjunction with the industry while also maintain UK's access to the most commercially viable block chain companies.

Based on the literature, the sand-box approach will be an interesting area for further development on Irelands and the EU's efforts at regulation. As the applications of distributed ledger technology would have implications for regulation across multiple agencies, (Primm, 2017) as in the case of the US, where application applying the likes of the Dodd-Frank Act, is slow paced and difficult to achieve, so too may there be considerations in Europe for the application of MiFID II and the EMIR reporting rules.

Shbair et al (2018) develop the area of regulation and blockchain technology. They specifically look at the area of KYC and how by utilising a test bed platform called Grid'5000 in order to offer insights for private and consortium blockchain developers to identify performance bottlenecks and to assess the behaviour of their applications in different circumstances. Their study takes the form of a case study whereby they analyse the usage of smart contracts to fulfil KYC requirements on a blockchain.

Their research identifies the current problems with traditional KYC; performing KYC is an easy task in countries that provide electronic services to verify a person's identity. However, if such services are not available to financial institutions it is risky to accept individuals as clients. Therefore, the KYC process performed when on-boarding a new client is time consuming and each financial institution must do its own KYC. This is an onerous task and incurs an element of risk. Their research parses that a blockchain solution can alleviate these concerns, primarily the KYC requirements for client onboarding. The blockchain of the public distributed ledger can disseminate the client's information across many banks, once verified. Thus, a KYC once performed can be accessed by other financial institutions with unique authorization from the client. This will make the KYC process much easier, simpler, less time consuming and cost-effective. Second, the centralized databases-based KYC solutions also reduce vulnerability. While in blockchain, the KYC data is replicated across many various nodes, which makes it immutable and traceable, because of blockchain's append-only data structure. Their workings showed that the

usage of a blockchain platform for KYC function is a feasible, usable and scalable technology to be used in the KYC regulation area and thus further AML capabilities.

Having discussed the regulatory impacts, this essay will next begin to examine the holistic viewpoint of the areas discussed previously, how the payments, models, trade and settlement and the regulations applied to them are interdependent and can be considered in a whole.

Conclusion

This literature review considered DLT within the context of the Asset Management industry with a specific focus on 'Trade and Settlement', 'Regulation' and 'General' consideration. The current research does not view or analyse this area in great enough detail nor does it provide enough industry-based views on the technologies effects on the incumbent system. Further analysis of the literature reveals virtually no application to the Irish industry.

Further to this, in regards to the Irish asset management Industry, there is no concise view on the regulatory environment that will be pursued for the technology. The literature centres on some of the larger global players and displays gaps, regarding Europe and specifically Ireland.

"In the future, all public services will use blockchain technology. Blockchain is a great opportunity for Europe and Member States to rethink their information systems, to promote user trust and the protection of personal data, to help create new business opportunities and to establish new areas of leadership, benefiting citizens, public services and companies. The Partnership launched today enables Member States to work together with the European Commission to turn the enormous potential of blockchain technology into better services for citizens".

Mariya Gabriel, Commissioner for Digital Economy and Society, (The European Commission, 2018)

In October 2017, Ireland as one of the signatories of the declaration on "Cooperation on a European Blockchain Partnership" agreed to, along with our European partners, to work together in the development of said technology in recognition of its potential transformative application to European digital services sector, in order to benefit citizens, societies and economies and with the full support of the European Commission.

Irelands signing of this declaration may allow one to examine our regulatory or general blockchain approach by our central bank from a more European view. By declaring our intentions as signatories, one may examine our blockchain approach from a European vantage. The declaration, point 7.b states:

By the end of 2018, assisting the Commission in preparing the technical specifications of this initiative, defining the appropriate governance model and identifying other framework conditions which are essential to its success (including compliance with regulatory requirements). Due consideration should be given to possible cooperation between the public and private sector

Having reviewed the current literature, the research indicates that further investigation is required in the specific areas of regulation and trade and settlement. While the overarching view is that blockchain technology, specifically DLT, will be adopted. There is not the necessary level of analysis on its effects on the trade and settlement process, the ramifications for third-parties and how the regulatory authorities will assess and police this new format of operations in the financial markets.

A key element of the development of the areas of both trade and settlement and looking at regulatory conditions, especially the KYC application of the technology, is the inter-linking and relationships of the areas. All formats of trade within the asset management industry are regulated in some format, either by the localised central bank or in the jurisdiction they are trading in, for example the Irish Central Bank or under European Union regulation such, as EMIR. Atzori (2017) contends that blockchain-based decentralized governance, challenges to varying degrees the traditional mechanisms of State authority, citizenship and democracy. She asserts that there will without doubt be a requirement for regulation, and that the anti-establishment, anti-government focused ideas of the usage of blockchain technologies, such as the anonymous usage of peer-to-peer payments per Bitcoin must be regulated for the greater security of society. This is where the areas of interest intersect in the form of KYC/AML areas of regulation and compliance and the trade settlement usage of blockchain technology. There appears to be a gap in the understanding of these areas and how the two will interact, per the asset management and trade finance industries and how the technology will allow innovation or augment the industry, in either a disruptively new approach or a gradual adoption.

This author would wish to further investigate, the approach favoured by those in the industry, whether they will be early adopters and first movers, or wait a wait and see approach. Leveraging off industry knowledge and utilising third party vendors and conceding some control or savings. These areas and questions on these specific topics will make up a key part of my research, areas I hope to expand our understanding and get some direct, measured and qualified responses on.

The literature review is followed by a presentation of the research questions for this dissertation. Following on from this is the methodology which predicate the interview process undertaken. The findings and analysis are presented and followed by the discussion chapter, linking this literature review to the interviews. Finally, the

limitations of the research are presented and guidance for future research opportunities is followed by the conclusion of this academic project.

Research Aims and Objectives

The research aims and objectives are to explore and investigate the critical areas of the application of Blockchain technology within the Irish Asset Management context, specifically expanding on previous researchers' findings and generalisations.

The ultimate research aim is to review, analyse and gain appreciation and understanding as to the implications of DLT on the Irish asset management industry. Particularly viewing the impact on the operational areas of trade and settlement and the regulatory approach to Irish asset management.

Following on from the area of trade and settlement and regulatory implications, the secondary aim of this paper will be to consider the wider impacts based around the areas. The aim is to gain insights into how the application of DLT will impact the surrounding areas of trade and settlement, and the regulatory environment. Gaining understanding as to whether there will be a fundamental change in the operational and regulatory processes and normative accepted conditions in these areas within the Irish asset management industry.

Primary Research Objective

"What are the implications for the Irish asset management industry with the adoption of blockchain technology, particularly within the operational areas of trade and settlement and the regulatory approach?"

Secondary Research Objective

When we consider the fundamental changes that may be apparent to the areas of trade and settlement and regulation within the Irish asset management industry with the adoption of blockchain technology, it is of key importance to consider the impacts on the surrounding processes, models and systematic industry norms. Secondary research areas are:

"If the technology is adopted, do intermediaries such as brokerages have a long-term future?"

"Do you see asset managers developing their own DLT technology for trading or using 3rd parties?"

"Is the Irish regulator heavily invested in the technology and should they be a key player in any development of regulatory processes surround asset management and DLT?"

"Are the DLT's capable of handling such large amounts of information used in a large asset managers transaction and the actual exchange on the blockchain?"

"As regards to payments, do you foresee SEPA and SWIFT being circumvented?"

"What model do you see asset managers adopting?"

"Will there be widespread cost savings?"

"Currently, is the Irish central bank concerned with this area? (in light of Brexit etc)"

"In terms of KYC and compliance, are the regulators not actively encouraging the use of the tech?"

"What are the implications for KYC/AML?"

"Do you see one of the larger players being the orchestrator, disrupting and gaining 1st move advantage? E.g Blackrock"

"Are the industry standards in danger of being replaced?"

"Will swift payments, high brokerage fees multiple sign off etc become a thing of the past?"

"Will a third party be the key to a widely adopted industry chain?"

"Do asset managers actually want this?"

Having filtered and extracted the relevant primary and secondary research questions based on the literature, the paper next begins consideration and appraisal of the most appropriate research methodology and strategies for achievement of the stated objectives.

Research Methodology

The below illustration denotes the extensive interconnections of the trade and settlement function within an asset management perspective. The interlinking areas, various stakeholders and interdependent business lines were key to formulating the research methodology and questionnaire.

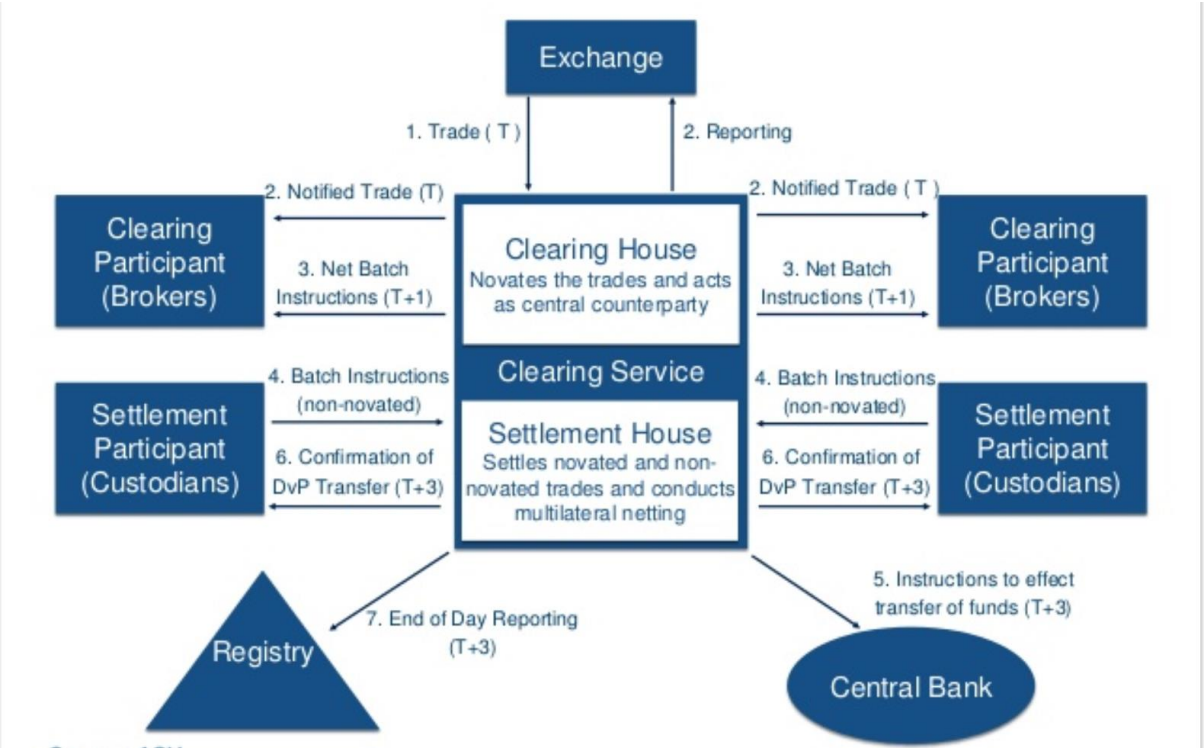

Fig. 9: Trade and Settlement Process (Authors own Collection, 2018)

As an employee of an asset management firm access to secondary information through business systems, business information providers and possible interviewees was utilised. Having 15 years work experience in the Irish asset management industry was also leveraged upon to identify and gain access to suitably knowledgeable and exposed interviewees to access primary data.

Various other research philosophies and approaches were investigated and deliberated as to their suitability to this research project:

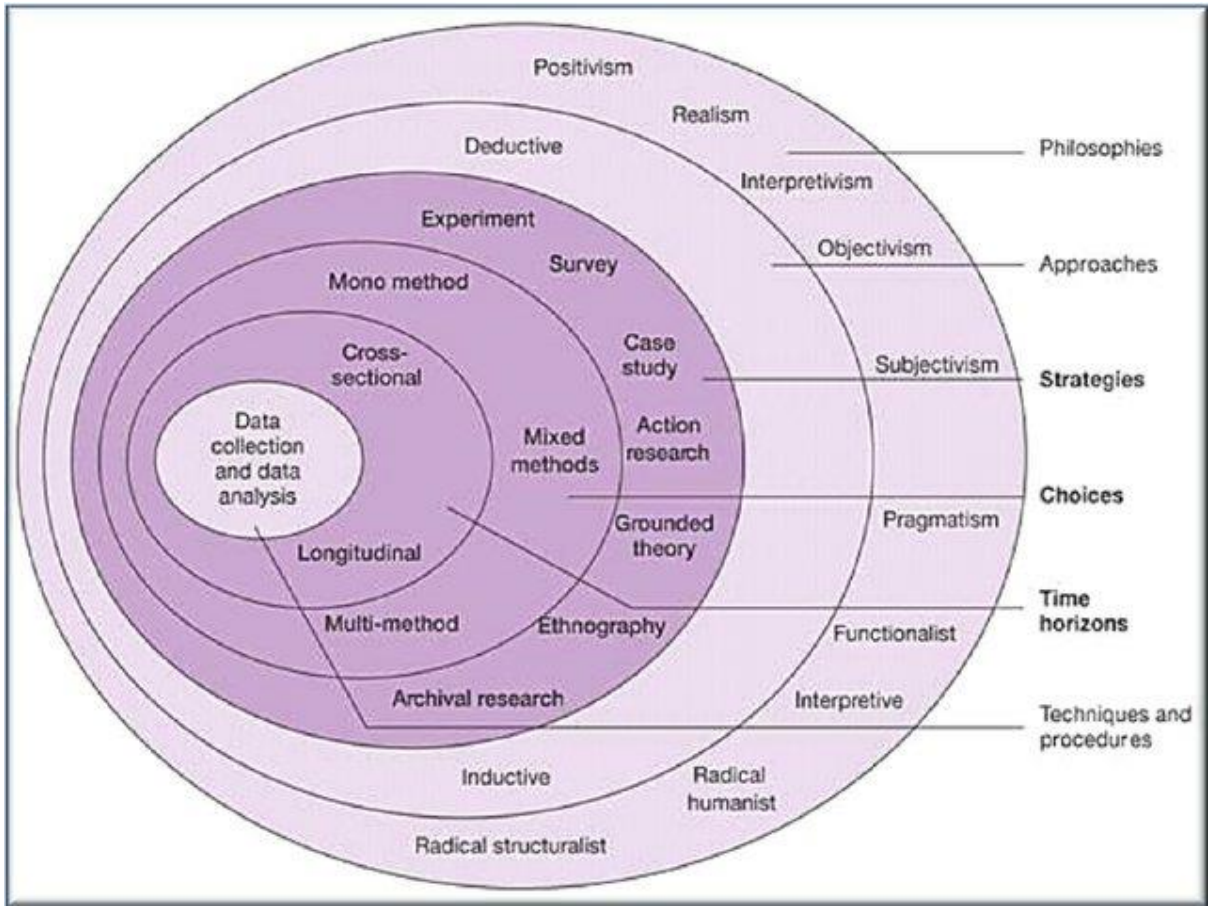

Fig 10 "The Research Onion" Source: (Saunders, Lewis and Thornhill, 2008, pg138)

The above illustration of Saunders et al (2008) visual construct of the research process provides easily understood and consumed overview of the function. From the outside to the in, a multiple layered approach is graphed, denoting the tiers of consideration before reaching the central point of data collection and analysis.

Philosophy

According to Saunders et al (2008) the research philosophy you adopt contains important assumptions about the way in which you view the world. These assumptions underpin your research strategy and the methods you choose as part of that strategy. However, Johnson and Clark (Johnson and Clark cited in Saunders et al 2008) note, as business and management researchers we need to consider the philosophical commitments made through our choice of research strategy since this has significant impact not only on what we do but we understand what it is we are investigating so that being considered, the philosophy adopted will also depend on practical considerations.

As regards to this research paper, a naturalistic approach was assumed, utilising interpretivism as the base philosophy, actioned via semi structured interviews, as the primary means of data collection. This approach was deemed to be most suitable considering the subject and practical considerations. Naturalism was deemed to be

suitable, considering the subjects and relatively small number of interviews would allow for a more expansive conversation, delimited, with less constraints. The basis being, the area is quite niche, therefore the required expertise and knowledge is limited to a small number of individuals, not conducive to large scale quantitative study, therefore qualitative was deemed the best approach. Regarding the epistemology, interpretivism was selected as the nature of the subject is new technology and it was deemed that feedback from qualified interviewees and their impressions and thoughts collated and reviewed, would benefit the research related to the subject and relative reactions within it. Furthermore, the research would be examining the role of individuals within the phenomenon, and the complex interplay and realisations of the impact of, in this instance "blockchain" would have on the processes, environment and perhaps social actions around them, this is the theory of assessment through social actors (Schwandt, 1994).

Research Strategies

In the initial planning stages, the total spectrum of research methods was contemplated. Initially, certain methods were ruled out as they were deemed incompatible with the subject, research and approach. Deductive quantitative methods via experiments, cross-sectional and longitudinal strategies were not considered viable for the phenomenon being researched due to the repetitious nature, long-term observation requirements and lack of experimental raw data access. Questionnaires and surveys were considered too limiting and constrictive to gain the deep, specialised and qualified insights into the niche and relatively new area of research required. Additionally, this researcher concluded the number of questionnaires required and the number of individuals proficient in the area would not have been compatible to achieve a usable sample size. Deductive quantitative research approaches did not suit the elaborating and opinion-based questioning utilised, to form research on a developing area of technology and industry change. Therefore, the qualitative interview method was deemed most suitable for such exploratory questions. In fact, as per the prescribed utility of the method by Silverman (1997), the major advantage is the ability to probe into responses or observations as needed, to develop more detailed explanations and of experience behaviours and beliefs.

The research design begins with certain philosophical assumptions regarding the nature of reality (ontology) and the relationship between the researcher and that being researched (epistemology). The ontological and epistemological stance, in turn, determine the methodology, or the way the researcher will go about finding out what he/she believes can be known (Guba & Lincoln, 1994)

Sample Profile

Participants for the research were considered through the scope of knowledge, experience and seniority. All interviewees were of high level executive standards, two European heads in a large asset management multinational, an innovation expert in one of big 4 accountancy firms a risk professional and financial experts in credit and technology. The varying roles, including information technology head, allows for a cross section of information and feedback, allowing for cross validity of others insights (Grbich, 2013).

Data Collection

Data analysis is quite difficult in the qualitative research. Interview data yields information unstructured and it takes a lot of effort, reading and re-reading the data several times to make sense of it. The entire process is time consuming. (Awashthy and Grupta, 2015).

The data collection took place over a one-month period. A semi-strucured conversational approach, orbiting themes was employed, delivering interviewees knowledge and experience and imparting their qualified, expert opinion. Hypothesis were formulated as interviews transpired, with the revelation to responses, insights and trends through the process, allowing for greater expansion of subjects that were deemed to be of import.

Inductive reasoning was utilised due to its suitability where there is limited availability of previous studies and those that are available are fragmented in relation to the phenomenon, as is the case for this research topic (Erlingsson and Brysiewicz, 2017).

Each interview began with open questions seeking the interviewee's opinions and values on key directional topics with a view to ascertaining and extracting their knowledge and experiences. The was recorded, with the permission of the interviewee and securely transcribed. No barriers to engagement with the research topic were experienced or encountered with or by participants. Hypotheses were enriched as the interviews progressed and as insights and similar trends and opinions were divulged.

A limited overview and introduction to subject phenomenon was communicated to the interviewees. Care was taken not to disclose any previous findings to mitigate against interviewee bias. Meyer (2001),highlighted this issue of separating the researcher's learnings from the literature review stage and striking a balance between asking open ended questions and refraining from inadvertently imparting previously uncovered knowledge.

Data Analysis

This section will review the mean of data analysis. Below is a basic graph of the stages and steps this research paper actualised in the creation of this paper.

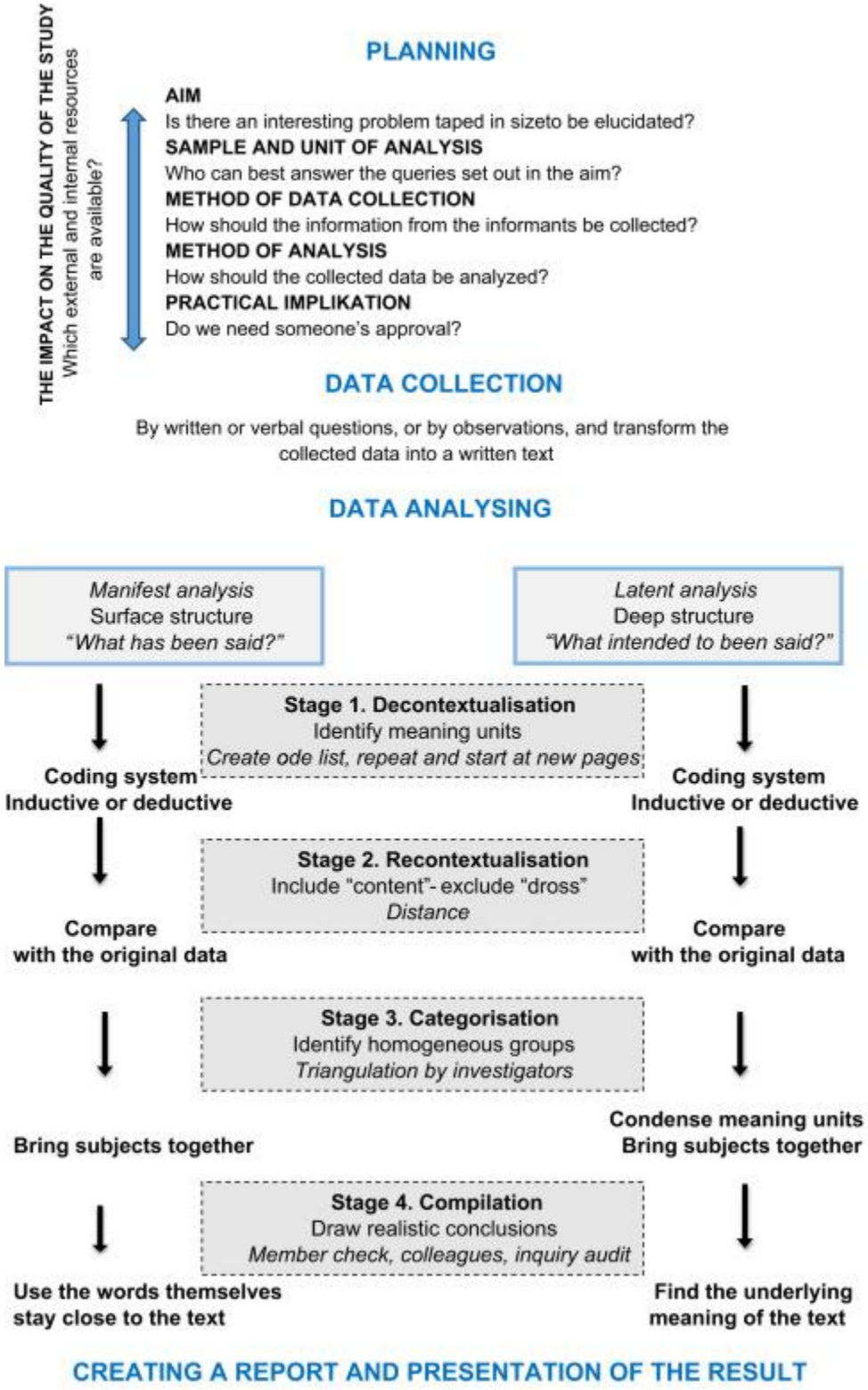

Fig. 11 An overview of the process of a qualitative content analysis from planning to presentation. Source (Bengtsson, 2016)

The step of decontextualization, aims to break the data down into smaller units of meaning .ie the smallest specific pieces of information from the data that provide relevance and meaning. This meaning is then allocated a code, using coding frames (Berg, Boston and Allyn, 2001). In the case of inductive reasoning, the code may be updated per the revelations of the ongoing interviews. This allows the researcher to develop the structure of reoccurring codes to observe themes, per theming data, also allocated, were magnitude and process coding (Walle, 2015). The next step utilised was recontextualization. Rereading the text with the meaning units, understanding the context from which they came and to remove that which is deemed unrelatable. The categorisation process allows themes to be posited, using a framework of relationship, frequency and meaning (Saldaña, 2010). Finally, the outcomes are compiled and presented. The researcher must decide between the credence given to the latent and manifest data, analyse, working through their respective themes and categories and develop the reasoned analysis from these workings, to finally create a valid output. This approach provided a systematic collection and analysis framework to date processing.

Validity externally was confirmed by comparison with peer literature and the confirmations in the similarity in outcomes ad assessments also through the application of triangulation to ascertain robustness.

Ethical Considerations

Firstly, all interviewees were advised of the reason why their insights and opinions were being sought. All participants were assured and guaranteed that their names, organisations and personal details would be preserved per the research and not disclosed or shared with other participants, and their details would remain anonymous within the published dissertation. Informed consent was obtained from all participants in the interview process.

Each interview was recorded using a mobile phone application or via a skype link and transferred to a secure location within the researcher's personal computer. The anonymised interview transcripts are held on files solely accessible by the researcher and password protected to guarantee the safety and integrity of the data. Following transcription, all interviews were deleted from the mobile phone to eliminate potential risk associated with loss or theft of the mobile device.

High ethical standards, privacy and confidentiality were maintained throughout all phases of the process from research design to data analysis, collation and reporting.

Limitations

The limitations to the research stemmed around the areas time and access, the requirement for such a vast area to be approached within the set-timeframe as well as the limitation to the selected areas of research in what fundamentally could be a whole industry-based project. Further limitations revolve around researchers find it difficult to investigate causality between different research phenomena. Qualitative research is little complex to determine the difference in the quality and quantity of information obtained from different respondents and arriving at non-consistent conclusions (Barbour, 2000) referenced in (Younus, 2014). Another consideration of samples in qualitative research are usability and non-probabilistic, the ability to claim a representative sample is often unsubstantiated, and statistical generalization is not possible (Guest et al, 2013). In the case of the research in this essay, perhaps feedback from the regulative authority would also have been an asset in the deliberation and findings of the thesis.

Findings, Discussion, Recommendations and Further Research

Findings and Feedback

In this section this paper reviews analyses and provides selected research questions and their stated answers. The data has been processed and collated, analysed and reviewed in order to provide feedback, discussion and recommendations on the areas of interest based on the interviews. The validity of the research has been heightened and confidence in the workings increased with the similarities in findings with much of the literary findings of other authors. Firstly, this paper will review the responses regarding trade and settlement.

Trade and Settlement

"As regards to matching and settlement, do you agree the technology could revolutionise the process?"

There was unanimous agreement from all interviewees that the area of trade and settlement is a key and likely area for the application of the disruptive blockchain technology. All parties, agreed that the speed of trades placed, matching and settlement would be an obvious change, in fact matching/reconciliation being eliminated from the process altogether, as one of the contributors noted:

"there is no need for reconciliation on a blockchain"

"the process should be instantaneous"

"the current process is not immutable, the blockchain is, which is huge for trade and settlement, therefore matching, is not a concern"

Further questioning related to the cost efficiencies gained from the changes to the trade and settlement functions.

Are there apparent cost benefits in applying the technology to trade and settlement?

This was also noted as an obvious area for efficiency gains and head-count

"reconciliation aspects and the like, the settlement and matching side, I think this is where it was probably going to have the biggest impact of the business like have been able to actually maybe reduce on all the people that would be required to do some of these work"

"At some point, some guy will come with a blockchain solution that's going to be cheaper than the rest. So for us, it will mean they will say, instead of trading for an eight bps or whatever, yeah, do you want to do that for five bps? And before we say yes, there is going to be a second one that's gonna come with four bps. And before we say yes, there's another one is gonna come with three bps, because it's really, really, really, really scalable technology. I mean, here by scalability is not the right word, it is becoming more and more scalable in terms of the number sure, still a limitation. Okay. But what I mean by that is the number of manuals the number of actual salaries and reconciliations and time wasted, and different systems that you have to be concerned with each other and, and data and everything that it saves is just huge, right!?"

"So from a middle office perspective for settlements, reconciliation teams that do a lot of that between the third parties and ourselves. And so that's where I would have seen aspects, to where I could have had a big impact on us, it would have reduced the actual timeframe of the actual settlement as well."

"If so, do intermediaries, such as brokerages, have a long-term future?"

The responses generally agree that intermediaries and brokers will still exist. The assertion being that the brokerages will have to adapt rather than being redundant, that while peer-to-peer trading or direct blockchain trading with exchanges could well be a possibility, the usage of brokers may adapt, be perhaps more niche, such as OTC products or exist as market makers, but essentially the consensus among the participants was that the brokers will utilise the technology themselves. Their role will transfer to utilising the blockchain technology, adding further efficiencies to the trade and settlement model, benefitting brokerages and intermediaries as well

"brokers often operate on the buy and sell side, if there is a means to be more efficient, a means of growing in the market or even if they sniff a disruptive

technology that they think can make them obsolete if they don't chase it, you can guarantee all of them have or are taking serious looks into this, maybe not ready to move in any big way just yet, but waiting to see how things pan out"

Another expert interviewed pointed out, that for example the use of the Bitcoin DLT is quite slow, but that should a broker or asset managers be using their public system or others available, they may consider doing parts of the process off book, ie. Uploading the finalised ledger entries of the data rather than perhaps the whole trade function on the blockchain.

Will they (asset managers) adapt, react or perhaps develop the technology themselves?

This area saw conflicting ideas. The responses varying in their views from self-development, to utilising 3rd parties or for a wait and see approach.

"The savings on blockchain are there but the change cost to the blockchain is could be more excessive than what they'd save over a period. So, it's all down to accounting at the end of the day. I mean, either you're saving a lot of money and the operation costs are low, or you're costing a lot of money to move to this model. Yeah, and I know to me, I think it's something that whoever does the first will obviously have massive, compact competitive advantage, you know,"

"So I think as buy side, guys, that's the way it will happen for us for all that is transactional for that is dealing with interfaces between us and other market participants. There is absolutely no reason why we should bear any cost of developing that they will come in, they will compete on price. And after competing on price, they will compete on service meaning in studied from it for you. We you know, I mean, and for us, it was OK. Cool. Can I just keep using it? I didn't see my trade. Yes, they've changed the fabric under that"

Payments

Can the European payments model of SEPA or the international payments SWIFT be replaced by blockchain technology?

There was an affirmative consensus from all parties, notably all highlighting the technology in theory is tailored to that end.

"the instant transfer of value is exactly what you want in a payments system"

"All the attributes that are required in the current models already exist or can be included and better"

"this is what's already happening with bitcoin"

Will the incumbents be replaced and why, why not?

"Perhaps, in time, it maybe a case of you wont even know, the architecture will change in the background"

"Currently, there isn't a ledger able to support the number of transactions occurring, plus, its still to risky for such a large-scale project"

"I'm sure the appetite is there, and that we will see a world standardised approach, the question is the models, the holding of all this data, the institutional, supranational support, is that there, is it in the interest of the larger players to take on the risk"

Regulation

Is the regulator heavily invested in the technology?

"I think they are kind of looking at, but I think it's taken a bit of a back seat now with all the Brexit issues. And so on day interim, they've got other bigger concerns right now, I think at the moment, as you can imagine, like a notch. And a lot of it is, I suppose, as well as such, from a regulatory perspective, you know, you're just, and I suppose it's the same with a lot of voters here in the buy side or not, you really need to have buy in of multiple players, and you need a lot of people to kind of come to the table. And then when all of those come to the actual table, then for them, their job is, you know, it could be much simpler or not until there's no like, it has many indication of whether they're like, a, like a sandbox approach or anything like that, or, or is it more of a wait and see, I get somebody to something that really just sitting back."

Are they (the Irish regulator) adopting the technology?

"not that I'm aware of"

"they don't need to be active in this, they will react I think, should the technology

become ubiquitous"

In terms of KYC and compliance, are the regulators not actively encouraging the use of the tech?

"I'm not sure if they are actively encouraging it, in terms of asset managers, they have to perform the KYC and then reflect this to the regulator, so its not necessarily placing the onus on the regulation side, now there are advantages for all parties if its done correctly"

"honestly, I don't think so, they're not at that stage yet"

"it's a good opportunity for a third party"

Further questioning relating to the asset managers and KYC/AML and the advantages of blockchain

"absolutely, and existing, immutable, traceable, trail for the regulator, it sounds ideal"

Do you agree regulators should be given direct access by the industry?

The interviewees agreed that there is no issue here, as long as its managed and set up correctly, essentially as long as competitors aren't capable of seeing what one is doing on the chain in, so much as they could gain a competitive advantage.

"you know, you don't really want all of these other players to see what you're buying into and what you're actually you're selling at the time because it could be given away a competitive advantage in some shape or form. So what they were looking at is to be able to actually prioritize certain areas and certain amounts of the information that would be honest and exposing it more for the likes of the actual regulators so it's kind of more privileged base and blockchain and capabilities in behind so I could see something like that been more drafted by the market then then full transparency"

"Yes, in so much as we are transparent at the moment, I mean we provide the data requested, so should the correct privileges or criteria, or designated keys be in place there shouldn't be an issue, as long as the data isn't wholly consumable or available to all on the blockchain"

The wider implications

Do you see one of the larger players being the orchestrator, disrupting and gaining 1st move advantage?

"you know, the areas in banking and so it's very quick additional been many ways but they put technology quite forward I've been incredibly risk averse yeah so if against this kind of thinking that like if a trusted name if someone that you know you've been doing a business or an assistant established big entity in the markets if if one or two of them get a board we were saying look guys we're moving to this tea as for general usage you know"

"I just think it's too obvious you know a very large incumbent you know there's just too much to be lost you know the thing about it is that you go for life and if you're you know if you're in trouble at the moment already or if you're not very if you're looking for growth or you know if you're very aggressive and stuff like that for you won't go 5%" (chance of the technology succeeding, referring to large entity cryptocurrency)

Operationally, is there any major issues with adoption?

", we would be one of the edges of the end of the stars, the bank is the one who is in the middle, you say I said, the Bank A, in an abusive manner. But you know what I mean, right? The bank the agent or broker, the citizen. So, number one, we're in it in the right position to do that. So it's, it's difficult, it will mean that will have to go and talk to the, you know, go and talk to the guys and why would they start sharing information with us?"

Can you see "Clearing" being impacted?

"Yes, it can only make it easier"

"Clearing could be far more efficient and transparent, it's a bit convoluted, so, them positioning of collateral, and instant requirement fulfilment that could be done on a blockchain would be really good"

Discussions

Thematic repetition was evident in each particular area of phenomenon addressed. These themes can be expressed as, efficiencies, risk, disruption, analysis, replacement and information. These are consistent patterns across the data.

All findings are linked back to the underlying literature and theory as previously recounted by other academics, writers and researchers in the field.

This paper has previously outlined our questions and areas required for research and investigation, having deliberated the feedback and applied the research theory rigour the next section will develop the recommendations.

Feedback Recommendations

Trade and Settlement

The previously referenced literature such as Freidlmaier et al (2016), along with various referenced grey literature are concerned with the cost benefits of the

technology. All interviewees agreed that the in the area of trade and settlement there are clear and obvious efficiencies to be gained. This was a trend seen across all participants, with consensus on the notion of matching being eliminated, speed of settlement and immutability, supporting the contentions of the literature such as Mori (2017) and Meiklejohn (2017). The data also confirms the assertions that the current standard trading model of trade and settlement will also be replaced (Pratham Mahajan, 2017) and the bridging of inefficiency gaps referenced by Walker (2017)

As regards to the use of clearing, brokers and intermediaries, the patterns over the data, indicate an evolution of the current model and uses. As opposed to clearing being removed, the responses indicate an ease of usage and a more defined transparent approach building on the literature of Platt et al, (2017). Similarly, brokers will utilise blockchain while still maintaining their role in the market.

The data also indicates that the usage of SEPA and SWIFT payments are ripe for disruption by blockchain the technology. Per the work of Jantoń-Drozdowska and Mikołajewicz-Woźniak (2017) the data indicates that properly utilised and scaled blockchain technology would be very much suited to cross-border payments.

Regulation

From a regulatory point of view, the data and responses insinuate a lack of direction from the Irish central bank. The interviewees relate little or no known correspondence or direction. In the case of the adoption and use of the technology from a regulatory perspective, the Central bank is not currently involved or adopting the technology, nor do they have any current intentions of. Unlike the UK, (De Meijer) Ireland has not formally endeavoured to set regulatory frameworks for the technology.

The general consensus is that the blockchain could prove to be a very useful tool in the areas of regulatory standards. Not only through the reporting capabilities, but also as a means of directly incorporating the protocols of regulation into the smart contracts. The data also supports the literature, especially the role the technology could play in KYC and compliance which it is considered to particularly useful (Stark, 2017). Trends emerge depicting the suitability of the technology for immutable, cross pollinated distributed ledger, which would prove a great asset for financial institutions, but also considered a formidable application of technology from a regulatory point view.

Other Findings

Other findings regarding the system in place and surrounding the usability of the technology, public ledgers such as Bitcoin according to the research of this paper are

too slow to transact to the standard required of Irish asset managers. This then leads to questions about private and consortium lead blockchains, whereby the issue surrounds their availability and desire of the Irish asset manager to participate or develop these themselves. As participants have highlighted, Irish asset managers may be less inclined to work together in areas that may gain a clear competitive advantage to a competitor, similarly, the wish to retain levels of privacy may hinder collaboration and finally they may deem the move to blockchain as too risky to adopt in the short-term. These findings contradict the literature of adoption which generally views the adoption as inevitable and preferential to the incumbent (Mori, 2016).

No clear trend in suitability of model emerged from the data analysis. All models are deemed to have their benefits, and the hybrid model advocated in the work of Walker (2017) is deemed to be one possible solution, but the general responses, concur that the other models also have their advantages and until the industry as a whole begins to move towards a solid path, they are unable to favour one over the other.

Recommendations

It is apparent from the responses and data that the application of the technology would be of great advantage. The evident change to the trade and settlement model, has clear and obvious financial and efficiency gains to its adoption and should be accelerated and implemented across the industry as soon as possible. Further to this, the risk reduction in an instant settlement period and the immutability of the technology add a greater robustness and confidence in the process and therefore add further credence to its adoption. Therefore, while adoption appears to be a straight forward positive, there are definite conditions to be met before the widespread benefits and reasons for take-on can be realised.

The competitive advantage of making the move may be apparent, but for many institutions an internal DLT will be the 1st step. This has some advantages, but currently is not as efficient as a standard database. This begs the question for the industry, unless there is a mass movement to a public blockchain such as Bitcoin or Ethereum. It would be the ***1st recommendation*** of this paper to develop internal private DLT in order to understand and build on the technology, in deference to the development of the technology, this approach leans itself to the opinions of the interviewees and Walker (2017). While Walker is in favour of a hybrid, the participants were unable to define a correct model of DLT. However, it has become apparent from the data, that an internal DLT is a low-cost entry into the area and would allow institutions to develop the technology and understand its limitations and advantages before adoption/usage of a public or consortium-based approach.

Similarly, the adoption and incorporation of the technology may depend on the size and nature of the financial institution. Concern raised by one interviewee about the

conservative nature of asset managers and how the adoption and development of the technology suits those with more to gain and less to lose. The inference being that for example, start-ups or low transaction or higher risk type asset managers may be more suited to the technology, allowing them far more scope and perhaps less risk in the total blockchain assimilation. Similarly, this supports the contention that the technology is not yet suited to mass adoption of high levels of data processing to the extent a large asset manager may require and supports the notion of waiting until either they have privately or through consortium developed a market feasible DLT or wait until the pubic options are able to meet their needs. Therefore, building on the 1st recommendation, it is the ***2nd recommendation*** of this paper that institutions consider their place in the market, understand there are opportunities, especially with the full-on adoption of a blockchain model. However, this is not without great risk, and if they are in a certain position, ie. Low trade volumes, conducive to the usage of Bitcoin or Ethereum and are not limited by their risk profile, then yes, consider full implementation.

The papers next recommendation is the use of blockchain and money transfers. Current crypto-technologies are too volatile to be used as a standard for international transfer. However, should the advent of pegged coins make a more assured currency method then it is the recommendation of this paper that, SWIFT and SIPA develop the technology as the curators of this system and perhaps not replaced per the views of Jantoń-Drozdowska and Mikołajewicz-Woźniak (2017). Their 3rd party positioning would allow them to bring the technology to the market without disrupting the current process and allow for a seamless transfer and efficient employment of the technology in international payments, so in this case the **3rd recommendation** of this research paper is the use of blockchain technology as a facilitator of international payments, as a method incorporated into and with a view to oust the current technology and process.

Finally, interviewees have highlighted, areas of concern, economic conditions such is the adoption cost effective in the current market. Mcmyn and Sim, (2017) highlight the issues with achieving global consensus, Cucco et al (2017), discus limitations of the blockchain model. The concern here is that currently, until there is a common assault, or catch-up in the technology to support the asset management functions, is there an economic incentive to move to the technology. The ***4th recommendation*** is to not to expect the technology to instantly gratify, the blockchain space, especially amongst the asset management sector is developing and needs to meet certain standards before the benefits can be delivered.

The ***5th recommendation*** would be for a 3rd party to develop and maintain a KYC system based on DLT. The advantages seem obvious and the interviewee responses along with the literature such as Stark (2017) corroborate the assertions that this is an area keenly suitable to the technology.

The ***6th recommendation***, is for the Irish regulator to formally begin a process of involvement as seen by their European and British counterparts. The technology is developing and without their involvement, they may find themselves and the industry in a situation where their outlook and situation is incompatible. It would be beneficial for all for a mutual regulator and industry approach.

Further Research

There is scope for further research in the area of technology usage. There are obvious short comings in the technologies capabilities in its current form for mass application. There are technological advances occurring in the field such as headed technology, or proof of stake which would eradicate some of the issues currently holding back certain aspects of the technology application.

Further to this, an area of interest may be the type of institution most suitable for adoption and whether the disruption may take place away from the current large players or perhaps an institute from a sector unrelated to asset management such as an Alphabet or Amazon.

Summary

Conclusion

It is clear from the literature, both academic and industry, that the prevalent belief is that blockchain technology is going to revolutionize the financial services industry (Guo and Liang, 2016; Trautman, 2016; Deloitte, 2017). These contentions are supported by the research in this paper, but only to a degree. All sources agree that there is huge potential as a disruptor to the sector. However, these assertions should be made with caveats.

When considering the area of trade and settlement, there is much consideration of the cost efficiencies available should the technology be applied (*Santander 2017*; Neyer and Geva, 2017).However, what the research undertaken has displayed is that while these possible capabilities are perhaps available through the adoption of the technology, it is *only* apparent, when there are other parties to trade and settle with. Matching by nature requires something to match against, so while the figures and changes to the trade and settlement model would be beneficial, they can only be delivered if there is another party also utilising the DLT, and in reality, the full

extent of the benefits would require a mass onboarding by the sector of the technology.

From a regulatory point of view, the Irish government, is quite far behind other countries (Ducas and Wilner, 2017; Umarovich *et al.*, 2017), with no concerted approach in place towards blockchain technology. It is evident, that an approach will need to be adopted as the technology is developing, regardless of the current concerns and regardless of the Irish Central Banks lack of attention.

There do remain many advantages apparent in the regulatory area, as previously stated, as a function of meeting regulatory requirements, DLT and smart contracts may prove a very useful tool in, imbedding the requirements and regulatory standards into the transaction. Areas such as KYC have huge potential to develop, non-regional databases of information pertaining to individuals and entities, which would be of great benefit to regulators and authorities around the globe.

The use as a cross border payment mechanism, in many ways seems inevitable. The consideration being perhaps, the willingness of institutions and governments to perhaps give greater credence to crypto-currencies at the disadvantage of their sovereign currencies. The proven capabilities of Bitcoin, show that, an instant peer-to-peer value transaction is possible, however, the technology does exist, from a conservatively organised point of view, in contrast to some of the requirements of a rationalised, institutional approach. That is, some of the key elements, such anonymity, lack traceability, open to all and without oversight, are counter to any international payments systems requirements. It is therefore, reasonable, that the assumptions made by this paper, is that instead, a variation or new cryto-coin will be required for an international institutionalised process to be successful.

We can be sure that the technology will develop, we can be sure that large asset management firms the world over are looking into the technology(Cognizant, 2017) and we can be sure that we will see more reference and usage across all forms of industry. The question still remains as to whether Irish asset managers should wholesale adopt, or whether we will see incremental change, whether a large incumbent will force the issue or a 3rd party or consortium will facilitate the change. However, change is coming, and the old adage, *if you are standing still, you are going backwards* springs to mind - or as one interviewee put it "*it's disrupt or be disrupted".*

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Footnotes

[i] MiFID II and MiFIR will ensure fairer, safer and more efficient markets and facilitate greater transparency for all participants. New reporting requirements and tests will increase the amount of information available, and reduce the use of dark pools and OTC trading. The rules governing high-frequency-trading will impose a strict set of organisational requirements on investment firms and trading venues, and the provisions regulating the non-discriminatory access to central counterparties (CCPs), trading venues and benchmarks are designed to increase competition.

[ii] FIAT **Fiat money** is a currency without intrinsic value that has been established as money, often by government regulation. Fiat money does not have use value, and has value only because a government maintains its value, or because parties engaging in exchange agree on its value.[1] It was introduced as an alternative to commodity money and representative money. Commodity money is created from a good, often a precious metal such as gold or silver, which has uses other than as a medium of exchange (such a good is called a commodity). Representative money is similar to fiat money, but it represents a claim on a commodity (which can be redeemed to a greater or lesser extent).[2][3][note 1]

[iii] '**Dodd-Frank** Wall Street Reform and Consumer Protection Act ' The **Dodd-Frank** Wall Street Reform and Consumer Protection Act is a massive piece of financial reform legislation passed by the Obama administration in 2010 as a response to the financial crisis of 2008.

[iv] **Basel III** is part of the continuous effort to enhance the banking regulatory framework. It builds on the**Basel** I and **Basel** II documents, and seeks to improve the banking sector's ability to deal with financial stress, improve risk management, and strengthen the banks' transparency.

[v] **EMIR Regulation**. If, in the course of your business as an undertaking established in the European Union, you enter into derivative transactions you should be aware of your obligations under the**European Market Infrastructure Regulation** ("**EMIR**").