WHY DO FINANCIAL INSTITUTIONS IMPLEMENT BLOCKCHAIN TECHNOLOGY IN SECURITY SETTLEMENT? A CONCEPTUAL FRAMEWORK FOR BLOCKCHAIN BUSINESS CASES

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zur Erlangung des akademischen Grades

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Tag der wissenschaftlichen Aussprache: 28. Juni 2022

Berlin 2022

To all those people deploying technology to use our scarce resources more efficiently

Abstract

Blockchain technology (BCt) is thought to revolutionise the global economy. The post-trade settlement of financial securities is slow and requires intermediaries, resulting in a surge of related BCt projects. Yet, the aspects considered in the underlying business cases (BCs) have not been researched to date. To discover why financial institutions implement BCt in security settlement, we employed a qualitative research paradigm and sought answers to three research questions. First, concerning the suitability of existing technology models and frameworks, we show that none focus on BCt BCs. Second, iteratively in 2019, we conducted semi-structured interviews with 10 EU-based BCt experts and using grounded theory techniques, analysed aspects considered in BCt security settlement BCs. We abstracted six dimensions: the application area of the BCt, goals, risks, stakeholders, process and environment. We distinguish between BCs of assets existent only on-chain (native) and BCs of assets replicated on a Blockchain (non-native). While cost reduction was the paramount goal, 10 other goals emerged, including internal stakeholders' competences. Incompatible BCts are a BC risk; we highlight that a cooperative environment with industry standards is needed for BCt to reach its potential. In the BC process, a budget approach, rather than classical financial calculations, prevails and we conclude that this is due to technical and regulatory uncertainties. Third, we organised the six dimensions in a conceptual framework to support the implementation of BCt BCs. In follow-up conversations, experts approved our framework and suggested to develop it into a tool to score and rank different BCt BCs. Our work potentially provides a basis for future research on the success factors of BCt BCs.

Zusammenfassung (Übersetzung)

Die Blockchain Technologie (BCt) könnte weitreichende Auswirkungen auf viele Bereiche der Wirtschaft haben. Die Abwicklung von Finanzprodukten (Post-Trade Settlement) ist langsam und erfordert Vermittler. Dies hat zu einer großen Anzahl von BCt-Projekten geführt. Die in den zugrunde liegenden Business Cases (BCs) berücksichtigten Aspekte sind jedoch bisher kaum erforscht. Um herauszufinden, warum Finanzinstitute BCt in der Wertpapierabwicklung einsetzen, haben wir ein qualitatives Forschungsparadigma angewendet und nach Antworten auf die folgenden drei Forschungsthemen gesucht. Erstens zeigen wir in Bezug auf die Eignung bestehender Technologiemodelle und Frameworks, dass sich keines auf BCt BCs konzentriert. Zweitens führten wir im Jahr 2019 iterativ semi-strukturierte Interviews mit 10 in der EU ansässigen BCt-Experten durch. Unter Verwendung von Grounded-Theory-Techniken analysierten wir die Aspekte, die in BCs für die Abwicklung von Finanzprodukten berücksichtigt wurden. Wir haben sechs Dimensionen abstrahiert: den Anwendungsbereich der BCt, Ziele, Risiken, Stakeholder, Prozess und Umfeld. Wir unterscheiden zwischen BCs von Assets, die nur auf der Blockchain existieren („nativ“) und BCs von Assets, die auf einer Blockchain repliziert werden („non-nativ“). Während die Kostensenkung das vorrangige Ziel war, kristallisierten sich 10 weitere Ziele heraus, zum Beispiel die Entwicklung von Mitarbeiterkompetenzen. Inkompatible BCts sind ein BC-Risiko; wir betonen, dass ein kooperatives Umfeld mit Industriestandards erforderlich ist, damit BCt sein Potenzial ausschöpfen kann. Im BC-Prozess wird eher mit einem Budgetansatz als mit klassischen finanziellen Berechnungen gearbeitet; wir schlussfolgern, dass dies auf die technischen und regulatorischen Unsicherheiten zurückzuführen ist. Drittens haben wir die sechs Dimensionen in einem konzeptionellen Framework organisiert, um die Implementierung von BCt BCs zu unterstützen. In Folgegesprächen befürworteten Experten unser Framework und schlugen vor, das Framework in ein Werkzeug für die Bewertung und Einstufung verschiedener BCt BCs weiterzuentwickeln. Unsere Arbeit bietet potentiell eine Grundlage für zukünftige Forschungen zu den Erfolgsfaktoren von BCt BCs.

Table of Contents

1 INTRODUCTION 1

1.1 BACKGROUND AND RESEARCH CONTEXT 2
1.2 RESEARCH MOTIVATION AND ENCOUNTERED PHENOMENON 6
1.3 RESEARCH PROBLEM, GOALS AND QUESTIONS 7
1.4 CONTRIBUTIONS OF THIS DISSERTATION 9
1.5 STRUCTURE OF THIS DISSERTATION 9
1.6 THE RESEARCHER, RATIONALE AND AUDIENCE 10
1.7 ACKNOWLEDGEMENTS 11

2 LITERATURE REVIEW 12

2.1 APPLIED CONCEPTS 12
2.2 THE DOMAIN OF BUSINESS CASE FRAMEWORKS AND MODELS 17
2.3 BLOCKCHAIN TECHNOLOGY (BCT) IN SECURITY SETTLEMENT 22

3 METHODOLOGY AND RESEARCH APPROACH 30

3.1 RESEARCH PARADIGM AND APPROACH 30
3.2 GROUNDED THEORY METHODOLOGY (GTM) 32
3.3 RESEARCH SAMPLE 36
3.4 RESEARCH DESIGN 41
3.5 ETHICAL CONSIDERATIONS 51
3.6 ISSUES OF TRUSTWORTHINESS AND AUTHENTICITY 52

4 FINDINGS 56

4.1 APPLICATION AREA 56
4.2 PROCESS 60
4.3 GOALS 70
4.4 STAKEHOLDERS 75
4.5 RISKS 77
4.6 ENVIRONMENT 80
4.7 KEY FINDINGS 85

5 EXISTING MODELS AND FRAMEWORKS 87

5.1 THE MOST CLOSELY RELATED EXISTING FRAMEWORK 88
5.2 SUITABILITY OF THE BCRF 89
5.3 RESEARCH QUESTION I: KEY RESULTS 94

6 ASPECTS OF BCT SECURITY SETTLEMENT BUSINESS CASES 98

6.1 APPLICATION AREA 98
6.2 PROCESS 108
6.3 GOALS 118
6.4 STAKEHOLDERS 132
6.5 RISKS 135
6.6 ENVIRONMENT 142
6.7 RESEARCH QUESTION II: KEY RESULTS 148

7 THE BLOCKCHAIN BUSINESS CASE FRAMEWORK (BCBCF) 154

7.1 DIMENSIONS OF THE BLOCKCHAIN BUSINESS CASE FRAMEWORK 154
7.2 RESEARCH QUESTION III: THE BCBCF AND PRACTITIONERS' FEEDBACK 164

8 DISCUSSION 171

8.1 EXISTING MODELS AND FRAMEWORKS 171
8.2 KEY ASPECTS OF BCT SECURITY SETTLEMENT BUSINESS CASES 173
8.3 A FRAMEWORK TO ASSIST THE IMPLEMENTATION OF BCT BUSINESS CASES 185

9 BIBLIOGRAPHY 189

10 APPENDIX 201

List of Figures

Figure 1 Comparing a centralised with a distributed ledger (Bannwart, 2016) 3
Figure 2 Settlement in the securities' value chain, based on Frey and Burton (2015) ... 4
Figure 3 Abstraction of the business case framework (Post, 1992) 19
Figure 4 Framework for developing a business case (Ward et al., 2008)..... 20
Figure 5 "The complete business case" (Ward et al., 2008)..... 20
Figure 6 Business case research framework (Maes et al., 2014)..... 21
Figure 7 Conceptual model of organisational adoption (Holotiuk & Moormann, 2018) 22
Figure 8 Traditional post-settlement process (Manning, Sutton, & Zhu, 2016)..... 24
Figure 9 Hybrid stratified purposeful sampling strategy 37
Figure 10 Constant comparative theoretical sampling research design 41
Figure 11 Main and sub-dimensions of the BCRF (Maes et al., 2014)..... 89
Figure 12 Blockchain business case framework (BcBCF)..... 156

LIST OF TABLES

Table 1 Summary of contacted interview participants..... 38
Table 2 Summary of interviewees, organisations and description..... 40
Table 3 Example of coding process..... 47
Table 4 Summarised findings: Application area..... 57
Table 5 Summarised findings: Process – before execution 61
Table 6 Summarised findings: Process – during execution..... 64
Table 7 Summarised findings: Process – after execution 69
Table 8 Summarised findings: Goals..... 70
Table 9 Summarised findings: Stakeholders..... 76
Table 10 Summarised findings: Risk factors..... 77
Table 11 Summarised findings: Environment 81
Table 12 Overview of considered models and frameworks..... 87
Table 13 The business case research framework summarised (Maes et al., 2014).... 90
Table 14 Summary of evaluation: Application area – use of BCt 100
Table 15 Summary of evaluation: Application area – description..... 100
Table 16 Summary of evaluation: Application area – advantages..... 103
Table 17 Summary of evaluation: Application area – assumptions..... 106
Table 18 Summary of evaluation: Process – before execution 108
Table 19 Summary of evaluation: Process – during execution 111
Table 20 Types of Blockchain, Hileman, Rauchs (2017); M. T. Oliveira et al. (2019) 114
Table 21 Types of private Blockchains encountered in the analysed business cases114

Table 22 Summary of evaluation: Process – after execution 117
Table 23 Business case goals cross-referenced with application areas..... 119
Table 24 Business case goal of cost reduction cross-referenced with application areas 120
Table 25 Business case goal of risk management & reduction cross-referenced with application areas 123
Table 26 Business case goal of political & regulatory reasons cross-referenced with application areas 125
Table 27 Links between the goal of increasing transparency and other goals 127
Table 28 Summary of evaluation: Stakeholders 132
Table 29 Summary of evaluation: Risks 135
Table 30 Summary of evaluation: Environment 143
Table 31 Summary of the Blockchain business case framework (BcBCF)..... 157

List of Excerpts

Excerpt 1 Interview with Blythe Masters (Van Steenis et al., 2016) 5
Excerpt 2 Definition of the business case framework (Post, 1992) 18
Excerpt 3 Interview excerpts on business case goals..... 121
Excerpt 4 Interview excerpt on business case goals..... 131
Excerpt 5 DeLone and McLean (1992, p. 87) on the aims of a model 155
Excerpt 6 Structure of feedback conversations..... 165

List of Abbreviations

Abbreviation	Meaning
ABS	Asset-Backed Security
AIM	Alternative Investment Market
ALM	Anti-Money Laundering
API	Application Programming Interface
ASX	Australian Stock Exchange
BcBCF	Blockchain Business Case Framework
BCRF	Business Case Research Framework
BCt	Blockchain Technology
CCP	Central Counterparty
CHESS	Clearing House Electronic Subregister System
C-level	Management level (such as CEO, CIO or CTO)
CSD	Central Securities Depository
CSE	Canadian Securities Exchange
DeFi	Decentralised Finance
DL	Distributed Ledger
DLT	Distributed Ledger Technology
DvP	Delivery vs. Payment
ECB	European Central Bank
ERP	Enterprise Resource Planning
FCA	Financial Conduct Authority
FMI	Financial Market Infrastructure
FOMO	Fear of Missing Out
GT	Grounded Theory
GTM	Grounded Theory Methodology
IPO	Initial Public Offering
IRR	Internal Rate of Return
IS	Information Systems
IT	Information Technology
KYC	Know Your Customer
LBO	Leveraged Buyout
MVP	Minimal Viable Product
NPV	Net Present Value
OTC	Over the Counter
POC	Proof of Concept
PSD2	Payment Services Directive2
R&D	Research and Development
ROI	Return on Investment
SME	Small and Medium-Sized Enterprise
SPF	Single Point of Failure
SPV	Special Purpose Vehicle
STO	Security Token Offerings
T + # of days	Working Days it Takes to Settle a Trade, after Trade
VAR	Value at Risk
VBA	Visual Basic for Applications
VC	Venture Capital
WpHG	*Wertpapierhandelsgesetz*

1 Introduction

The ideas for this inquiry developed between 2015 and 2017, when Bitcoin punters were made millionaires, Blockchain start-ups were mushrooming and corporate financial institutions were scrambling to somehow put this new technology into action. These observations triggered our interest about why organisations, or more precisely, their decision makers were behaving in this way, what potentials were driving their decisions and what risks they were encountering. By focusing on a specific area within the financial services industry, namely the settlement process of financial institutions' securities businesses, the researcher and his PhD supervisor (hereafter referred to as "we") aimed to investigate why Blockchain technology (BCt) was being implemented.

To further narrow the focus of our research, we sought to analyse business cases. A business case is commonly understood as the rationalisation for an investment decision, under consideration of all relevant aspects, such as objectives and cost, usually but not necessarily presented in the form of a formal document; it allows for a deep understanding of the aspects considered in the implementation process of an IT project (Einhorn, Marnewick, & Meredith, 2019; Maes, Van Grembergen, & De Haes, 2014; Ward, Daniel, & Peppard, 2008).

Whilst the use of a Blockchain for the "post-trade settlement process of financial securities" (hereafter referred to as security settlement) is widely recognised amongst practitioners (ECB, 2021; Lord et al., 2017; OECD, 2020; Schneider et al., 2016) and academia (Cucculelli & Recanatini, 2021; Priem, 2020), the underlying motivations are not. To make sense of this, we approached this phenomenon following an inductive qualitative research approach, iteratively conducting in-depth interviews with 10 business experts operating in Europe and then repeatedly analysing and comparing the obtained data to yield concepts and, under consideration of their relationships, a conceptual framework thereof (M. Miles, Huberman, & Saldana, 2019, p. 15).

To support this strategy, a grounded theory (GT) approach seemed to be the most adequate methodology, given that it can be applied well to make sense of "*how individuals interpret reality*" (Suddaby, 2006, p. 634). Answers to our questions were likely to be rooted in multi-dimensional, complex human interpretations; GT is thus promising for yielding new concepts to explain the underlying reasons and processes (Gregor, 2006).

IT projects are known for their high complexity and high failure rates, which have resulted in significant resource wastage. According to the widely cited Standish Chaos Report, which has monitored the topic since 1994, although the rate has decreased, in 2015, 19% of IT projects were still categorised as a failure, and 45% of the projects were challenged, resulting in a bleak success rate of only 36% (Standish-Group, 2015). The need to assist practitioners in the implementation of BCt business cases seems apparent, given that BCt is widely recognised as requiring a highly complex implementation (Pawczuk, Holdowsky, Massey, & Hansen, 2020) for diverse reasons, not least the requirement of various parties to interoperate.

Successful BCt implementations have the potential to radically change the settlement space, not only disrupting a multi-billion-dollar industry but also saving immense resources (Cucculelli & Recanatini, 2021; OECD, 2020; Watkins, 2018). With our goal to establish a conceptual framework, in the sense of a web of connected concepts to make sense of a phenomenon (Jabareen, 2009), we hope to assist practitioners in their "planning, execution and evaluation" (hereafter referred to as implementation) of BCt business cases potentially to increase the success rate of BCt business case implementations and possibly to provide a basis for further research inquiries.

1.1 Background and Research Context

Over the past 10 years, "Blockchain" has evolved from a hype into a strong commitment, deeply entrenched in the strategic thinking and technology implementation of organisations across almost all economic sectors (Pawczuk et al., 2020). The original use of BCt for cryptocurrencies and the first peak of the cryptocurrency Bitcoin in December 2017, after rising 2,377% over the preceding year, likely propelled interest. The topicality of the subject is highlighted by the rapid growth and innovation of the Blockchain industry both, within and beyond the finance industry. Within finance, all types of decentralised, Blockchain based and interoperated financial market innovations are now frequently referred to as "DeFi" (decentralised finance). As an indication, measured in the volume of transactions, as of 2022, the public Ethereum Blockchain has settled trillions of dollars worth in transactions, of which the overwhelming majority relates to crypto currencies (Economist, 2021; Sriram, 2021). Although these can be considered as financial securities in a wider sense, they are beyond the scope of this dissertation. Beyond finance and also beyond the scope of this dissertation, BCt is likely to be the backbone to new mega-trends such as digital assets, so-called NFTs (non-fungible tokens) and "web3". The idea of a third internet generation implies a shift back to more decentralised forms of data storage structures after the internet, in its first

generation was mainly decentralised and has become increasingly dominated by large and centrally organised data controlling institutions in its second and arguably, current generation.

BCt is hailed to bring about changes in the magnitude of the internet, yet it is understood by few (Hileman & Rauchs, 2017; HSBC, 2017). The term “Blockchain” (a registered term and thus always capitalised) refers to a specific database that is not stored on one central storage facility but instead on several interconnected computers, referred to as “nodes”. The synonymous name “distributed ledger” (DL) reflects this idea. “Block” and “chain” describe the method of recording data changes and additions in the form of subsequent blocks in a chain (Van Steenis, Graseck, Simpson, & Faucette, 2016).

BCt is the software technology that enables a Blockchain to work. Whereas data was conventionally stored and distributed centrally (left image of Figure 1), BCt enables data to be exchanged directly between parties (right image of Figure 1) across multiple nodes. Such a distributed peer-to-peer network has been experimented with and used for over two decades. However, BCt introduced two elements that ensure direct transactions between parties.

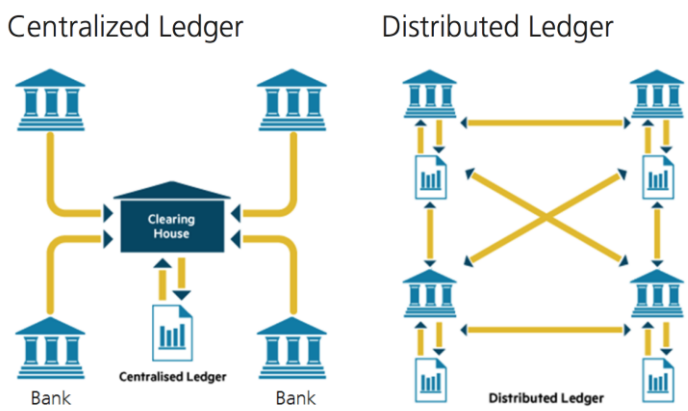

Figure 1 Comparing a centralised with a distributed ledger (Bannwart, 2016)

BCt introduced cryptography, incorporating a so-called “hash value”, which is a cryptographic password connecting the individual blocks within their chain (Hileman & Rauchs, 2017). Furthermore a “consensus mechanism”, such as proof-of-work and proof-of-stake ensures the consistency of the stored data across all the network’s nodes. These elements render the technology a new and potentially revolutionary software concept because all additions, changes and accesses to the data are recorded on the

chain, can be trusted without having a "*trusted central authority*" (Nakamoto, 2008, p. 2) and can practically not be changed or manipulated (Van Steenis et al., 2016).

Given the interconnection of the individual blocks, changing the stored data would require a recalculation and rewriting of all subsequent blocks and given the consensus mechanisms, in the case of the Bitcoin Blockchain as an example, over 51% of the network's computational power would be required for such a majority attack (Lee, 2015). Hence, the term "immutable record" is commonly used and is the key feature for transaction parties that otherwise lack trust, to transact directly with one another in what are referred to as "*trustless transactions*" (Chong, Lim, Hua, Zheng, & Tan, 2019, p. 1309). BCt may thus offer solutions to wide-ranging questions of data ownership, control and security. It is hailed for reducing transaction costs and increasing data transfer speeds (ASX, 2018; Deubel, Moormann, & Holotiuk, 2017).

A fundamental interest in BCt is on the rise throughout academia (Xu, Chen, & Kou, 2019) and both the private and public sectors (Hileman & Rauchs, 2017). A survey published by Deloitte in March 2020 found that from over 1,000 responding companies globally, 55% considered BCt to be critical and a top priority in 2020 compared to only 43% in 2018 (Pawczuk et al., 2020). For example, the German Bundestag issued a whitepaper launching a Blockchain initiative in 2019, with the aims of creating a reliable environment for BCt ventures, supporting them financially and implementing BCt in the German administration (Bundestag, 2019).

Practitioners have begun to understand that BCt bears the potential to transform complex and expensive processes throughout the economy, especially in transactions where multiple parties are not known to one another, as is frequently the case in financial markets (OECD, 2020). The "back office" is one such area in which ample rationale exists for BCt. The back office refers to "post-trade" processes, in other words, the administrative fulfilment after the trade has taken place ["T"]. It is also the area in which little innovation has taken place over the past few years relative to other parts of the securities' value chain – illustrated in Figure 2 and split into pre- and post-trade (Mellinghoff, 2018).

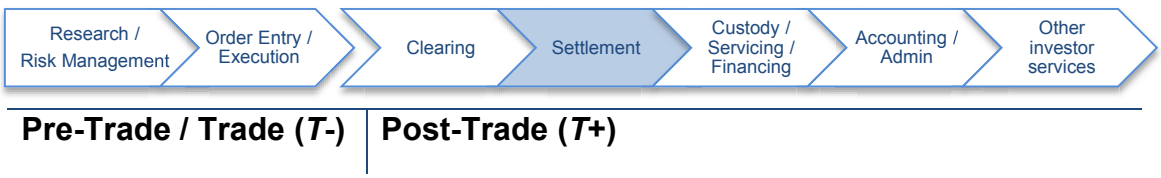

Figure 2 Settlement in the securities' value chain, based on Frey and Burton (2015)

Settlement can be generalised as the actual "exchange process" in which the buyer of a transaction receives what was bought, and the seller receives a cash amount in return; it takes place everywhere in our economy, for example over the counter of bakeries and on the servers of online shops (Frey & Burton, 2015). In a trade of financial securities, the buyer receives the title of ownership of the securities in exchange for cash, which is transferred to the seller. The process involves various administrative "steps" and several intermediaries, as we will explain in Section 2.3.1, page 23. Also, we delineate between clearing and settlement in Section 2.1.8, page 16.

Settlement is carried out electronically using a mechanism referred to as delivery versus payment (DvP) and depending on the asset class and regulatory framework only occurs, two or three business days after the trade took place (*T* + number of days); for syndicated loans the settlement can be as long as 21 days (Schneider et al., 2016). Excerpt 1, from an interview with the former CEO of the BCt solution provider Digital Asset Holdings, reflects the potential of the post-trade phase of a security transaction:

> *...there's been an arms race in pre-trade infrastructure for more than a decade now […] trading infrastructure has evolved to the point that competitive advantage is measured in fractions of nanoseconds and yet we're still dealing with T plus two, three or worse, depending on your asset class…*

Excerpt 1 Interview with Blythe Masters (Van Steenis et al., 2016)

Within the post-trade phase, settlement is thought to offer one of the largest potentials for the application of BCt, given the involvement of several intermediaries, whose processes may be slow, manual and without much value addition in a world where technology can provide trust (Holotiuk, Pisani, & Moormann, 2017; OECD, 2020; Schneider et al., 2016). This potential is reflected in the numerous projects and start-ups in this area (Hileman & Rauchs, 2017). For example, Faircom, a Canadian portfolio company, wishes to develop a BCt post-trade solution, and the German Bundesbank, together with Deutsche Börse Group, established a proof of concept (POC) of a BCt-based, high-volume settlement system. The interest in settlement appears logical, considering that an optimised settlement process not only promises to reduce the cost of transacting but also, by speeding up the transaction, could reduce the time that capital is unavailable during a transaction, thereby reducing the cost of capital, increasing liquidity and reducing counterparty risk (OECD, 2020; Priem, 2020; Yermack, 2017).

1.2 Research Motivation and Encountered Phenomenon

Although increasing research has been devoted to the topic of BCt from a wide variety of academic disciplines (Xu et al., 2019), with only five to 10 years of conducted studies, the research field is still relatively young. Areas of strong interest have been the underlying functioning (Fill, Härer, & Meier, 2020) of BCt, such as peer-to-peer technology, cryptography and consensus mechanisms (Christidis and Devetsikiotis 2016; Cruz et al. 2018; Kraft 2016). Furthermore, legal practitioners have analysed the legal setting and regulation of BCt, which are important, considering that BCt can enable the purely digital automation of legal processes that, previously and depending on the jurisdiction, still required form fulfilment to the extent of signed paper contracts. Beyond this, technologically, BCt allows for entirely new asset classes, solely existent in digital form and referred to as “on-chain”, which call for regulatory updates (Hess & Spielmann, 2017; Paech, 2016).

More recently, potential applications of Blockchain have moved into high focus (Laroiya, Saxena, & Komalavalli, 2020), often based on case studies of POCs and implementations (Meier & Stormer, 2018). In this context, the impact of BCt – both threats and potentials – have been analysed for various industries, such as the banking sector (Beinke, Tönnissen, Samuel, & Teuteberg, 2020), supply chain management in freight and logistics (Eickemeyer, Lattemann, Halaszovich, & Busch, 2020) and energy trading (Teufel, Sentic, Niemer, & Hojcková, 2020), and even for more general topics of society such as electoral voting (Meier, 2020) and intellectual property rights (Fill & Härer, 2020). As a consequence of these far-reaching potential applications of BCt, new and changing business models have gained the attention of researchers (Chong et al., 2019; L. Oliveira, Zavolokina, Bauer, & Schwabe, 2018; Pawczuk et al., 2020), as have the organisational adoption (Holotiuk et al., 2017) and applicability of BCt (Werner, Mandel, & Zarnekow, 2020). A study conducted between December 2016 and May 2017, published in the summer of 2017, found that although a large number of public sector institutions, including central banks, had launched POCs, only 6% of the sampled 57 had deployed a live system (Hileman & Rauchs, 2017).

This advent of BCt in economy and society motivates our interest and research; it seems fair to posit that BCt may evolve into the database of choice and hence the backbone of our future. With this awareness becoming a reality, it is logical that the number of BCt projects are rising (Pawczuk et al., 2020). We focus on the financial services industry and, within that, the settlement of securities because based on our earlier elaboration, the potential application of BCt in this niche is vast and widely recognised (CSE, 2020;

ECB, 2021; Laroiya et al., 2020; OECD, 2020). Yet detailed analysis and models or frameworks of underlying BCt business cases for such implementations are non-existent and scarce, respectively.

A valuable contribution of our research is thus the enhancement of both academic and practical understanding. Indeed, in 2016, Mills et al. (2016) reported that one of the challenges to adopting BCt for the clearing and settlement of payments includes the development of feasible business cases in consideration of technological and regulatory factors, amongst others (Mills et al., 2016; Priem, 2020).

The phenomenon we encountered was that financial institutions are engaging in BCt projects with the aim to implement this new technology for their security settlement. We were curious about why decision makers decided to engage in this new technology, which aspects motivated them and which risks they perceived. In light of this phenomenon, and given that a business case is widely recognised as the foundation for new technology implementation (Ward et al., 2008), we chose the business case as the unit of analysis. We chose the grounded theory methodology (GTM) to explore the phenomenon exploratively and to develop research questions freely and flexibly, yet not too broadly, thereby ensuring a sufficient level of focus (Corbin & Strauss, 2015).

1.3 Research Problem, Goals and Questions

The encountered phenomenon of BCt implementation reflects a substantial trend in database technologies and can thus be regarded as critically important for organisations and practitioners alike in the field of financial security settlement and beyond. With a deep understanding of the motivations and aspects surrounding this phenomenon, organisations can potentially control the implementation of BCt more proactively and ultimately implement BCt more successfully than without such prior understanding.

Following the outlined phenomenon above, we formulated the following preliminary **research problem**:

> *Financial service providers are implementing BCt in their settlement of financial securities. However, the aspects considered by the decision makers in the context of the underlying business cases appear unclear. No theoretical or conceptual model or framework exists to aid practitioners in their BCt implementation. We thus seek to reveal insights into the aspects considered in their decision-making, potentially to support the implementation of future BCt business cases.*

Given the encountered phenomenon, our research pursues two central goals:

i) The first goal of our inquiry is to analyse BCt business cases relating to financial institutions' security settlement activity and to understand the key aspects of their business cases and ultimately answer the question of why financial institutions implement BCt in their security settlement business.

ii) The second goal is to combine the derived concepts to build a new conceptual framework with which practitioners will potentially be able to plan, analyse and evaluate the implementation of their BCt business cases.

To address these goals, we formulated the following three research questions:

1. What existing models and frameworks are available to evaluate technology business cases, and how suitable are they to evaluate Blockchain technology business cases?
2. Which key aspects did financial institutions consider in their business cases to implement Blockchain technology for their security settlement?
3. What could a suitable conceptual framework to support the implementation of Blockchain technology business cases look like?

In pursuit of our research goals and consequential research questions, we followed a qualitative GT research approach according to "*flexible guidelines*", as stressed in multiple instances in the groundwork of GTM by B. G. Glaser and Strauss (1967) and interpreted, for example, by Bryman (2016, pp. 375-378), Charmaz (2014, pp. 16-17) and Urquhart and Fernández (2016, p. 9). We elaborate on this in Chapter 3, Methodology and Research Approach.

Following the guidelines of Urquhart and Fernández (2016), and to maintain our objectivity, we conducted our literature review in phases. In a first "*non-committal phase*", we reviewed the literature, scanning a broad spectrum of knowledge. This enabled us to gain "*theoretical sensitivity*" and understand the current state of knowledge of our research interest (Bryman, 2016, p. 380; Myers, 2013, pp. 107-109; Urquhart & Fernández, 2016, p. 9).

To collect our data, we conducted in-depth interviews with 10 business experts who either had previously implemented or were in the process of implementing a BCt business case at a financial institution in the security settlement area. The motivation for our inquiry was explained to all interviewees during the scheduling of the interviews, which were recorded upon prior informed consent, transcribed verbatim thereafter, and

numbered from ID 1 to 10 to ensure anonymity. Following the Glaserian approach to GTM, we used GT techniques to analyse our findings in a number of iterative coding cycles, where we sampled, sorted and compared our codes to develop concepts from the detailed descriptions obtained from our expert interviews (Bryman, 2016, pp. 573-575; B. G. Glaser & Strauss, 1967, pp. 105-109; Urquhart, 2013, pp. 45-50).

1.4 Contributions of this Dissertation

The central aim of this dissertation was to identify the underlying aspects, which financial institutions considered in BCt business cases in the security settlement space. To achieve this goal, GT offered a chance to take our analysis to a higher abstract level, allowing for a conceptual and potentially general explanation of the encountered phenomenon (Charmaz, 2014, pp. 8-9).

Our work links the two fields of research on business cases and distributed ledger technology (DLT). We build on existing research whilst offering inspiration for a number of future research questions regarding this relatively new subject matter. Questions, for example, on the dependencies of aspects considered in BCt business cases could be tested in subsequent qualitative studies and with increasing maturity of the industry, even with sufficient quantitative data.

In the form of a new conceptual framework, these concepts may be useful to organisations seeking to implement BCt. Our framework may provide practitioners with both an agenda of which aspects to consider in a BCt business case implementation as well as a holistic picture of the various interdependencies. A comprehensible framework could ultimately aid in the understanding of and communication within a subject that is still surrounded with numerous uncertainties, thus allowing for more BCt business case implementations to be managed and completed successfully.

1.5 Structure of this Dissertation

Chapter 1 explains the background of our inquiry, the motivation, the research problem, the research gap, the potential contributions and ensuing research questions.

The first part of Chapter 2 considers available literature regarding existing technology models and frameworks, whilst the second part investigates BCt in the context of security settlement.

Chapter 3 describes the philosophical basis for our research, with the consequential ontology, epistemology and inductive GTM and detailed study design.

Chapter 4 presents our findings, structured in the form of our concepts and open codes.

Chapter 5 answers our first research question concerning existing models and frameworks to potentially evaluate technology business cases and their suitability for evaluating BCt business cases in the space of security settlement.

Chapter 6 constructs arguments using GTM to answer our second research question regarding the key aspects that were considered in the implementation of BCt business cases.

Chapter 7 seeks to answer our third research question, proposing a new conceptual framework for the implementation of BCt business cases, verified by feedback from business experts.

Chapter 8 concludes and discusses our key findings, contributions and limitations, structured according to our three research questions with an outlook for potential future research.

1.6 The Researcher, Rationale and Audience

At the time of carrying out this study, the researcher was a software entrepreneur with a finance background. The chair of the doctoral programme is an expert in digital business models with an interest in and a number of publications on the subject of BCt. The research rationale originated from our combined curiosity to uncover the underlying reasons why BCt is being implemented and to manifest a groundwork to analyse and guide business cases in this area. Given that BCt is explored by many mature businesses and start-ups, we hope to offer insights to those at the beginning or in the midst of a Blockchain project.

The ongoing stream of institutional and academic publications on the specific area of BCt in the settlement of financial securities before (Mills et al., 2016; Pinna & Ruttenberg, 2016) as well as during this dissertation (Cucculelli & Recanatini, 2021; ECB, 2021; Schuster, Theissen, & Uhrig-Homburg, 2020) reflects not only its significance but also the topicality and interest in the subject. Indeed, another potential audience may be policymakers who understand that their involvement on a regulatory scale is indispensable for the private sector to apply BCt successfully. A better understanding of BCt business cases may demystify the potentials, challenges and risks encountered by

practitioners, clarify what business environment can foster technological advancement and thereby assist in the formulation of policy and regulation.

1.7 Acknowledgements

I am most grateful to and would like to thank my professor and supervisor, Prof. Zarnekow, for his ongoing support. His attention and kindness, constant availability and fast responsiveness to guide me through this research effort were remarkable. Furthermore, I would like to thank Prof. Salomo and his research team for their feedback on my work, which allowed for an important refinement. I also thank all fellow PhD students of the department for the valuable, ongoing exchange of thoughts; they have contributed not only to this work but also to my personal development.

My thanks are directed towards our interviewees for taking the time and thereby making this research possible. In many cases, pragmatic decisions were taken to share knowledge.

Furthermore, I am grateful to my large and strong family – my parents and in-laws, my sisters and their husbands, all of whom have directly and indirectly motivated, supported and encouraged me in this endeavour and to persevere until the end. Beyond our families, I thank our small but precious group of friends for their respect for my decision to pursue this journey and their understanding, without ill feelings, that I would surely otherwise have devoted more time and attention to our relationships. My gratitude is also directed to my employees and business partners, who contributed to the successful continuation of our business despite my dual commitment.

The daily love and support of my magnificent wife, Dr. Lea Maikowski, was a fundamental cornerstone in the process of completing this dissertation. Her psychological and practical backing were invaluable. I thank her for her engagement in the endless minutia of academic questions, always with a pragmatic mind and intelligent suggestions, forcing me to focus whilst helping me to overcome encountered challenges. Together, we have mastered the plethora of daily challenges encountered in the process of completing a dissertation, whilst running a business and parenting three wonderful children.

2 Literature Review

Our study sought to understand why financial institutions implement BCt for their security settlement, based on the analysis of aspects which were considered in their underlying business cases. As part of this, we considered the given state of literature. In line with GTM, our literature review took place throughout the course of our research, from its "*preliminary (non-committal)"* phase through to the evaluation and discussion of our work (Urquhart, 2013, p. 29). In our previous introduction, we explained the fundamentals and background of BCt. To avoid repetition in our literature review, in this chapter, beyond providing a more detailed overview of the present state of research and knowledge on the subject matter, we seek to provide the necessary basis for answering our three research questions.

The first part of our literature review considers and clarifies our use of a number of central concepts in the context of our study. The second part concerns our first research question and reviews existing technology business case models and frameworks that could potentially be used to evaluate BCt business cases. The third part of our literature review relates to our second research question and considers key aspects in regard to why BCt is used in the settlement process of financial securities.

2.1 Applied Concepts

In this first part of our literature review, we consider a number of key concepts, delineating their relevance to our work.

2.1.1 Business Model

In 2004, in his seminal thesis on business model ontology, Alexander Osterwalder developed the Business Model Canvas and dissected the linguistic backgrounds of the words "business" and "model". He defined a business model as a description and prediction of a particular company's activity of buying and selling goods and services to earn money (Osterwalder, 2004). He further expanded this definition, stating that "*the business model is an abstract representation of the business logic of a company"* (Osterwalder, 2004, p. 14). Much work has been based on this Business Model Canvas, which, in essence, abstracts a business model to aspects of revenue generation and cost incurrences. At the centre of the model is a strategy or plan – the value proposition – with the aim for activities to result in greater revenue than cost generation, or in other words, to generate a profit (Chesbrough, 2010; Osterwalder, 2004).

The unit of focus of the business model is the organisation as a whole. The preceding definition focuses on the unit of a company, a firm or an organisation. Given that every action in the operations of a firm is ultimately about revenue and cost generation, whether productive or not, it is given that a business model pursues an all-encompassing approach (Zott, Amit, & Massa, 2011). This is confirmed by one of four common themes that were found in a literature review on business models, namely that business models adopt a “holistic” approach to explaining how firms conduct business (Chesbrough, 2010; Osterwalder, 2004; Zott et al., 2011).

As such, the business model as an instrument of analysis for a specific technology, and indeed for our purposes of analysing BCt, is too broad. In fact, confusion is often caused by the use of the term “business model” in reference to only a single part of a business model, such as a specific technology or pricing model (Osterwalder, Pigneur, & Tucci, 2005). Although such a technology may be a key component of an entire business model, it is merely a part of the whole. Following the structure of the Business Model Canvas, a specific technology should be categorised as a “key resource” and potentially have a special purpose in the value proposition, but it remains only a part of the business model (Osterwalder, 2004).

2.1.2 Business Case

The term “business case” is used less frequently than “business model”. A query on Google Scholar, placing both terms in quotation marks, returned approximately 886,000 results for “business model” and only approximately 386,000 results for “business case” (Alphabet Inc., 2019).

Independently of its form, written or verbally presented (Einhorn et al., 2019), academic literature generally defines a business case as an explanation and, often, justification for a proposed investment with expected benefits (Maes, De Haes, & Van Grembergen, 2017; Maes et al., 2014; Sachs, 2011, p. 114). In addition to explaining the business circumstances, a business case likely consists of quantifications of expected costs and benefits in financial terms, although a number of issues have been raised about a purely financial focus in relation to IT business cases, such as a lack of verifiable and reliable data on which calculations are made (Einhorn et al., 2019; Krell & Matook, 2009; Ward et al., 2008). There exists a general consensus that a business case includes more than financial calculations and should not be limited to the obtainment of initial approval for an investment to be granted and a project to proceed (Gregor, Martin, Fernandez, Stern, & Vitale, 2006; Sachs, 2011, pp. 92,175).

2.1.3 Business Case versus Business Model

The terms “business model” and “business case” are frequently used in practice, and they are closely connected (Meertens, Starreveld, Iacob, & Nieuwenhuis, 2013). However, it appears important to distinguish between them and explain why we focus on business cases.

Different to a business model, which essentially explains the functioning (i.e. revenue model) of an entire company, a business case focuses on one particular project and is likely to go into more detail. For our purposes, we are primarily concerned about the motivations and other aspects that are considered as part of a business case to implement BCt in financial security settlement (BCG, 2012; Jaglan, Dalal, & Srinivasan, 2011; Morini, 2016).

A business case refers to a smaller unit of focus than a business model. In practice, an organisation commonly uses a business case for a segmented project, organised around a distinct action or segmented decision (Thompson, 2013). It does not have to be, but is often presented as a summarising document, such as a memorandum or presentation, that describes the core features of the business case – most commonly its costs, benefits and goals (Hsiao, 2008). Indeed, a significant feature of a business case is its inter-organisational use to ratify IT investments, and it has been shown that a business case fulfils a critical role in recognising and realising the value of IT investments (Ward et al., 2008).

The business case as a unit of analysis is well suited to analyse the implementation of new technology. For over three decades, it has been used as an instrument for analysing information technology projects and their investments (Maes et al., 2014). Post (1992) was possibly the first to relate the business case to the evaluation of a technology project, establishing a business case framework (Post, 1992). As a unit of focus, we therefore determine the business case to be better suited than the business model.

2.1.4 Framework versus Model

The terms “model” and “framework” are closely related and are often used interchangeably or even synonymously (B. G. Glaser & Strauss, 1967, p. 136). Both are equally based on theoretical concepts (Basoglu, Daim, & Kerimoglu, 2007; Wiesche, Jurisch, Yetton, & Krcmar, 2017).

In line with existing work on business cases, hereafter we adhere to the term “framework” because it has a legacy of being used to break down a particular subject matter into smaller units, often referred to as variables or dimensions, to facilitate a subsequent analysis, comparison and prioritisation of the component parts (Basoglu et al., 2007; Ward et al., 2008).

2.1.5 Concept versus Theory

Jabareen (2009) provides a list of characteristics of a concept, highlighting the idea that a concept is based on a number of components and should be seen within the specific context. In support of this, Imenda (2014, p. 88) opines that the “*meanings/interpretations of concepts are largely influenced by their contexts”* and suggests that a concept ultimately refers to an amalgamation of abstracted thoughts. Based on this, we employ the definition of a concept being an “*abstract idea*” (Charmaz, 2014, p. 342).

“[…] *theory uses concepts*” (Strauss & Corbin, 1990, p. 20) so that a theory is arguably based on interconnected concepts and reflects a higher level of abstraction than a concept. In addition, Imenda (2014) proposes that a theory contains explanatory and predictive powers. Adhering to these ideas and standards for a theory, the development of a theory would exceed the scope of our dissertation, and we focus on the development of concepts.

2.1.6 Conceptual Framework versus Theoretical Framework

In our work, we seek to develop concepts, explore the relationships between them and subsequently establish a conceptual framework (M. Miles et al., 2019, p. 15). A conceptual framework is seen as an artefact combining related concepts, whereas a theoretical framework is built on theory (Imenda, 2014).

Jabareen (2009) delineates a conceptual framework as one based solely on concepts, rather than variables or factors, to provide interpretive comprehension of reality. Accordingly, we use the term “conceptual framework”, or its abbreviated form “framework”, in reference to the framework developed in this thesis.

2.1.7 Implementation versus Adoption

The terms “adoption” and “implementation”, as well as “acceptance” and “use”, are closely connected and often used interchangeably (Hwang, 2005). Given that the aim of IT business cases is often technology adoption, acceptance and/or implementation, a clarification of our use of the terms is valuable.

Following Robertson (1971), we consider adoption to be the “acceptance and continued use” (Robertson, 1971, p. 56) of, for example, a technology. Indeed, the connection between “adoption” and “use” is commonly recognised, as in a definition measuring information systems (IS) success by different levels of use (DeLone & McLean, 1992; Robey & Zeller, 1978). Therefore, concerning a technology implementation, adoption can be seen as part of the implementation; Basoglu et al. (2007) prominently name poor adoption as a reason for failed enterprise resource planning (ERP) implementations. Given that our focus is on business cases, we use the term “implementation” to include the planning, execution and evaluation of a business case.

2.1.8 Settlement versus Trading and Clearing

In practise, the terms “clearing and settlement” as well as “trading and settlement” are frequently used together so that we prefer to delineate them in the context of our work. As shown in Figure 2, page 4, both clearing and settlement occur after the trade has taken place. In that sense trading or “trade execution” is the activity of buying and selling and ends when the buyer and seller have agreed to the terms of the trade (e.g. security, quantity, price) and the trade is “filled” by the broker (Schneider et al., 2016; SEC, 2013).

Clearing is everything that takes place between the trade and the settlement of the traded good; during the clearing process, a central counterparty (CCP) ensures that the terms of the trade and its confirmation are fulfilled in the settlement process (Frey & Burton, 2015). For certain financial securities, clearing commonly takes place through CCPs also called clearinghouses, as shown in Figure 1 on page 3. The clearinghouse acts as a risk mitigation in two ways: it steps into the legal position of both buyer and seller, thereby reducing the counterparty risk of the trade and it nets the trades throughout the day, thereby reducing the total gross settlement exposure of trading party (*ibid.).*

Settlement is the actual process where the traded financial security is being exchanged for cash in what is called delivery versus payment (DvP). Here the investor’s custodian (i.e. a bank) transacts with the custodian of the seller, exchanging security for cash via the clearinghouse. The custodians are connected to a Security Settlement System, run by the CSD, where the trade is being settled in book entry form (Frey & Burton, 2015). A complicated “matching” process takes places, so that the correct settlement instructions of both custodians are linked and executed simultaneously (*ibid.).*
Although “clearing and settlement” are frequently used in one term and for certain assets are handled by the CCP, in our dissertation we focus on the post-trade activity of settlement. Clearing can theoretically be considered as an optional, risk mitigating

service that has been established and proven its usefulness in the past (Frey & Burton, 2015). Whereas it is commonplace and required by regulation for certain asset classes, it is not strictly necessary. However settlement always has to take place. Regardless of whether the trade takes place via an exchange platform or between two parties over-the-counter (OTC), in a regulated or unregulated market, with or without a clearinghouse, the delivery of securities from one account in exchange for the payment of cash from another account always has to take place.

2.2 The Domain of Business Case Frameworks and Models

In this second part of our literature review, we first consider the literature on business cases and, subsequently, business case models and frameworks. After revisiting the concepts in context, we consider three business case models and frameworks from the literature in more detail. This literature review is the basis for our evaluation and answer to our first research question, in Chapter 5, what existing models and frameworks are available to evaluate technology business cases, and how suitable they are to evaluate Blockchain technology business cases.

The number of references to business cases has been on the rise during this millennium (Maes et al., 2014). As considered in our earlier explanations, business cases fulfil a number of purposes in the process of IT project implementation to justify an investment decision; they not only highlight the risks, involved stakeholders and alternative options but also extend far beyond plain cost-benefit calculations and management's approval (Bennett, Buttrick, & Stanton, 2017, p. 48; Krell & Matook, 2009; Maes et al., 2017; Sachs, 2011, p. 113). The use of business cases outside the area of IT is beyond our scope, with literature most commonly applying and investigating the business case as a project management tool to decide between alternative investment projects on financial and economic terms (Messner, 2013; Ren, Nakamura, & Ludwig, 2014).

Within the IT space, the business case is said to hold special importance (Einhorn et al., 2019). This is arguably due to the exponential relationship between IT projects' size and complexity, which can be ascribed to the necessity to manage both technical and human interfaces, often high opportunity costs and the inevitable involvement of many different stakeholders (Jordan & Silcock, 2005; Nielsen, Persson, & Nielsen, 2019).

Progressing from our consideration of the business case, we turn to our more specific interest in business case models and frameworks. The business case is included as an element in a number of conceptual frameworks. Post (1992) included it as an entity in their technology-supported group-process enterprise model to compare IT-supported

and non-IT supported group work and found that a business case approach is valuable to evaluate an IT project. Dyllick and Hockerts (2002) argue that the business case plays a key role within their theory to improve corporate sustainability, and Sachs (2011) views the creation of a business case and selection of investments as part of a process to plan and control capital allocations. Post (1992) defines a business case framework as in Excerpt 2.

> *The business case framework is a straight-forward conceptualisation and analysis of the concerns that should be considered when attempting to make sound business technology investments […]*

Excerpt 2 Definition of the business case framework (Post, 1992)

To add to the above definition under consideration of the existing models and frameworks, these generally include a process orientation. Process-orientated business case frameworks and models can aid in the development and approval of a successful business case, as with a "*business-case methodology*" to justify a business case (Sarkis & Liles, 1995, p. 180) or a "*development road-map*" with inputs, tasks and outputs to develop a business case (Keen, 2011, p. 115).

Some models and frameworks go beyond the development, presentation and justification of the business case and focus on either the process of adoption of a particular technology (Smart, 2010) or the process of applying the business case over the course of an IT project (Einhorn et al., 2019). Such models also exist in the professional practitioners' literature, for example in the course material of project management and IT associations, to cite PRINCE2® as an example (Bennett et al., 2017, p. 49).

The increasing importance of IT projects as drivers for corporate value creation (Ward et al., 2008) is likely attracting increasing academic attention for researchers to engage with such professional process frameworks. The IT governance and management framework COBIT 5, for instance, was explored by Pereira, Ferreira, and Amaral (2017) and Maes et al. (2017) in the contexts of their business case process model and framework, respectively.

Given our research goals, we are less interested in the exact process of developing or executing a business case but more concerned about the aspects that were considered in the BCt business cases throughout their planning, execution and evaluation.

Accordingly, we have selected three conceptual models and frameworks that consider aspects of the business case throughout its implementation.

2.2.1 Business Case Framework for Group Support Technology (1992)

Post (1992) was possibly the first to relate the business case to the evaluation of technology projects, proposing the above-cited definition in Excerpt 2. He conceptualised important aspects when conducting technology investments and focused on the analysis of a business case within a complex organisation (Post, 1992). The technology was the software TeamFocus, which offered solutions to improve teamwork, including tools for team evaluation, voting and questionnaires as well as an internal knowledge database. The author defined 45 business case variables to quantify "*costs, benefits and qualitative considerations*" (Post, 1992, p. 8) as represented in the abstracted Figure 3 below.

Cost	Benefit
Qualitative Consideration	

Figure 3 Abstraction of the business case framework (Post, 1992)

From these 45 variables, using their business case framework, Post (1992) identified five variables that were valuable in measuring the technology in question, namely efficiency, quality, effectiveness, customer satisfaction and decision-making. He thereby supported the finding that a simple cost–benefit analysis is inadequate in the evaluation of IS, mainly because it proves unable to measure intangible assets (Matlin & O'Lakes, 1979). Despite his study having been conducted almost 30 years ago, it is remarkable that, irrespective of the considered software technology, his findings are timeless, applicable and noteworthy.

2.2.2 Framework for Developing a Business Case (2008)

Based on a combination of case studies, action research and a survey, Ward et al. (2008) proposed six steps to create a business case, considering interesting aspects. Ward et al. (2008) sought to offer a solution to widespread disappointment (69%) amongst more than 100 surveyed European organisations regarding their lack of aptitude to develop and manage their IT investments successfully, despite using a business case (96%) to recognise and measure anticipated benefits (Ward et al., 2008). In their six-step process, the authors grouped the expected benefits by a scale of concreteness and a type of change, as shown in Figure 4.

Degree of Explicitness	Do New Things	Do Things Better	Stop Doing Things
Financial			
Quantifiable			
Measurable			
Observable			

Figure 4 Framework for developing a business case (Ward et al., 2008)

Financial calculations were found to be the most concrete, and observable benefits, the least concrete. It was argued that for a benefit to occur, either novel actions must be undertaken, existing actions must be improved or obsolete actions must be surrendered. This is noteworthy given that a technology investment and consequently a business case most likely pursues several "benefits" beyond purely financial ones and that these must ultimately be related to one of the three decisions (Ward et al., 2008).

Integrating this in their sixth and last step, Ward et al. (2008) proposed that one should consider a business case holistically, as shown in Figure 5, where each benefit is assigned particular costs and risks.

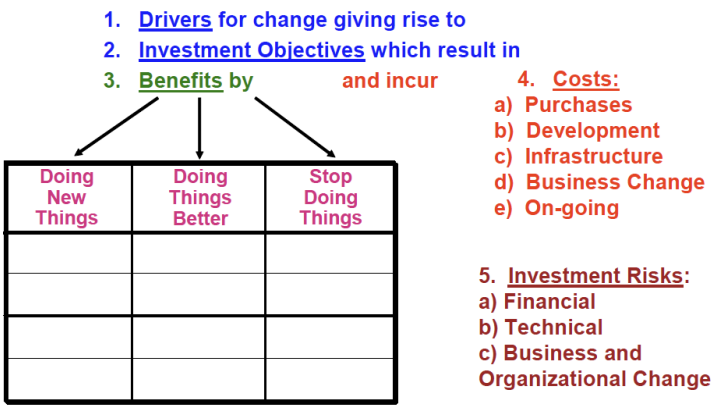

Figure 5 "The complete business case" (Ward et al., 2008)

From this part of their research, two findings appear relevant for our inquiry. First, management tends to be most concerned about "financial benefits" that can be expressed in financial cost savings or revenue increases. However, the realisation of these benefits may in fact depend on the merely "observable benefits" of a technology investment. An example for this is the "observable benefit" of staff working well with a

new technology implementation, which is decisive for an efficiency increase and financial improvement (Meertens et al., 2013; Ward et al., 2008). Second, the authors found that it was easier to quantify benefits concerning the change or abortion of existing technologies than that of new technologies (Ward et al., 2008). A predominantly non-quantitative approach for new technology business cases has been found elsewhere, too (Smart, 2010).

2.2.3 Business Case Research Framework (BCRF)

The business case research framework (BCRF; Maes et al., 2014) is meaningful to consider because it provides a structure to analyse business cases based on a dedicated and structured literature review that addresses the research gap and need for knowledge synthesis for the business case as an essential tool to yield benefits from IT investments (Maes et al., 2014; Ward et al., 2008). Maes et al. (2014) searched for the term “business case” via multiple databases for the time frame 1990–2011, filtering 169 relevant references from 495 first results. The authors analysed and organised the text fragments in which “business case” appeared, using a qualitative content analysis, ultimately producing six dimensions that offer different angles from which to consider a business case, as illustrated in Figure 6 (Maes et al., 2014).

Figure 6 Business case research framework (Maes et al., 2014)

The three above-presented frameworks constitute a valuable contribution to a universal consideration of technology business cases. Our research goal was to explore aspects not of any technology business case but of BCt business cases and furthermore, in the financial industry and the particular area of security settlement. Therefore we seek to develop a new framework that, although inevitably will include some of the aspects of the above-mentioned models and frameworks, will be geared specifically towards BCt in the security settlement space.

As part of our literature review, we also considered BCt-specific models and frameworks unrelated to business cases. Holotiuk and Moormann (2018) developed an adoption model, as depicted in Figure 7, considering BCt in their technology dimension. With regard to BCt in particular, the question concerned the changes that had to take place within an organisation for BCt adoption to occur. The authors addressed the need for collaboration and the resulting organisation of relationships, both internally and externally. They argued that adoption was only possible if people with corresponding skill sets were available to execute the tasks. Project management is considered necessary given that Blockchain implementation is a lengthy and complex process, comparable with other large-scale IT projects such as ERP systems (Holotiuk & Moormann, 2018).

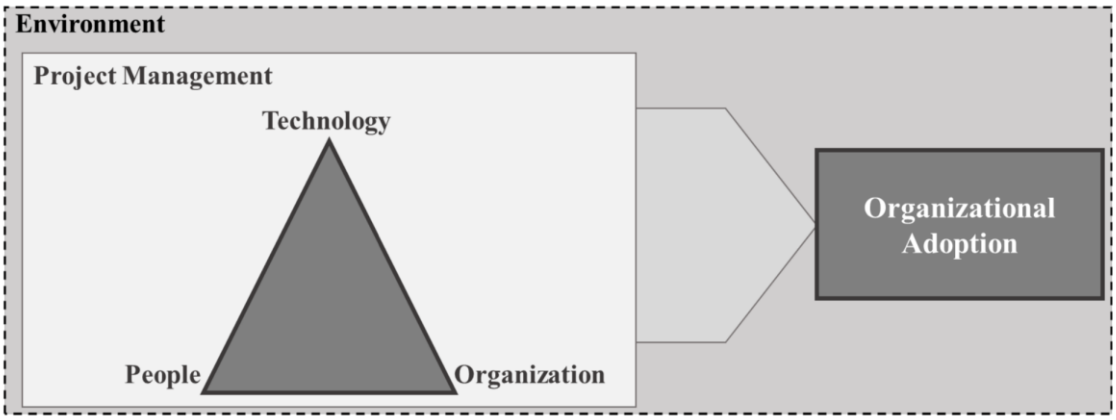

Figure 7 Conceptual model of organisational adoption (Holotiuk & Moormann, 2018)

Another argument is that a business case can be used to progress technology adoption (Smart, 2010) or that technology adoption ought to be an aspect of the business case process, such as for product line software (Maes et al., 2014). Despite our consideration of several technology adoption models – also with regard to the adoption of technologies of similar complexities to BCt, such as ERP systems (Basoglu et al., 2007) – and many interesting aspects therein, we must realise that these are only tangential to our research questions. After all, our main focus is not the adoption of BCt but aspects considered in its implementation, with the aim to answer why financial institutions implement BCt in their security settlement.

2.3 Blockchain Technology (BCt) in Security Settlement

The third part of our literature review relates to our second research question (which key aspects were considered in the business cases of financial institutions to implement BCt for their security settlement?). The most relevant statement concerning BCt in relation to

business cases may still be that of Lord et al. (2017). These authors pointed out that multiple projects are in progress to explore the BCt business case, commonly with the central question of whether benefits surpass costs and risks, for both stand-alone implementations and improvements to existing systems.

As outlined in our introduction, literature concerning BCt in the finance industry is scattered across different areas. A large part of the literature concerns the digital payment industry, which can be related back to the fact that BCt's primary application was the root of cryptographic currencies, which is not the concern of our inquiry. Next, we highlight seven aspects that have frequently been found in relation to BCt in the security settlement space. The seven aspects concern the reduction of transaction cost in security settlement, the disintermediation of stakeholders, an increase in settlement speed, an increase in security, greater transparency, interoperability and common industry standards as well as risks.

2.3.1 Reduction of Transaction Costs in the Area of Security Settlement

The most frequently observed aspect of BCt business cases is the potential and indeed the goal to reduce costs. More precisely, a large potential exists in the area of security settlement, where an increase in the efficiency of processes can lead to a reduction in transaction costs (Van Steenis et al., 2016). Beyond a decrease in the number of stakeholders involved in the process, this argument also relies on an improvement in the slowness and resilience of processes within financial markets (Holotiuk & Moormann, 2018).

The traditional DvP system is designed to ensure that delivery only takes place when due payment occurs, thereby acting as a link between the settlement of cash and a financial security (Collomb & Sok, 2016). This process, as Figure 8 illustrates, using the trade of a cash equity, for example, without any derivative components, usually involves brokers, aggregating brokers, clearing members, often banks providing leverage and a clearinghouse (i.e. CCP). Furthermore, one of the brokers likely uses a third-party custodian (i.e. bank), and there is ultimately the central securities depository (CSD). The number of involved parties can amount to eight or more, with an equivalent or higher number of process steps, as represented by the numbers 1–8 in Figure 8.

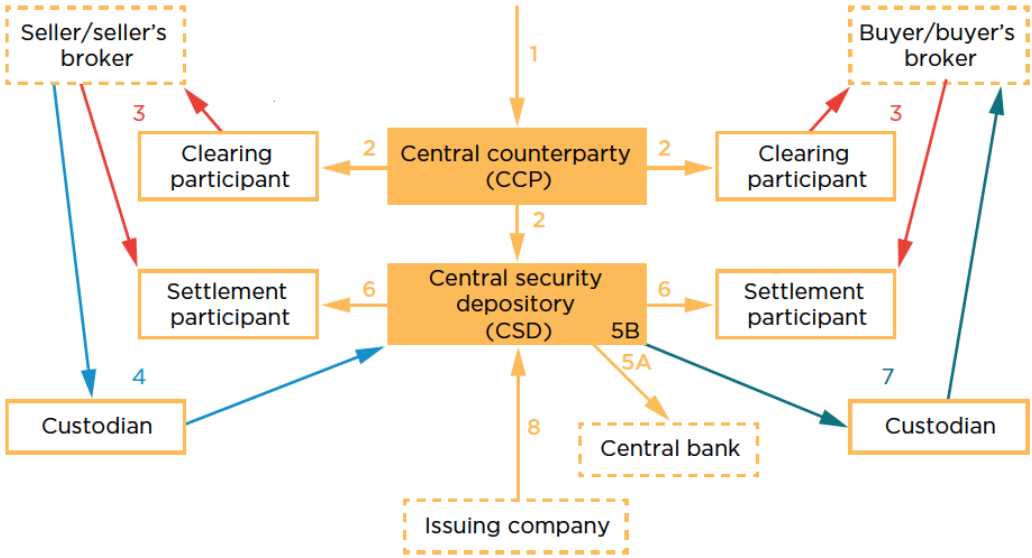

Figure 8 Traditional post-settlement process (Manning, Sutton, & Zhu, 2016)

Clients frequently act through brokers, who then interact with the clients' custodians, usually banks, which provide accounts to hold securities and cash; the banks hold the securities in central security depositories (CSDs) (Frey & Burton, 2015). In Europe the two main CSDs are Clearstream and EuroClear; in the USA, ICE settles credit default swaps and DTCC clears and settles American shares. Effectively settlement does not occur between the transacting parties but between their custodians via the CSD. The actual costs incurred per trade depend on the traded asset, the number of intermediaries involved, the required services and their fee structures; there usually exists a minimum fee and variable fee, depending on the traded volume.

Members of the R3 Blockchain consortium of more than 80 financial service providers believe that BCt can reduce administrative costs in the financial system by reducing inefficiencies and the need for trade insurance from payments, trade finance and syndicated loans to equity clearing (McLannahan, 2016). Santander, Wyman, and Anthemis (2015) suggest that banks' infrastructure costs could drop between $15 to $20 billion p.a. through the implementation of BCt for cross-border payments, securities trading and regulatory compliance. Concerning the post-trade and settlement more specifically, Deloitte estimated potential saving potentials of $2.56 billion p.a. (Bansal, Brodersen, & Sen, 2019).

2.3.2 Disintermediation of Stakeholders

Given that information is held across a number of interconnected nodes and that a change of data can therefore only take place if the data of all nodes is collectively

changed, a higher integrity of data is seen as an important aspect of BCt business cases, especially for situations where counterparties do not trust one another but can trust the ledger (Manning et al., 2016). In the past, such a situation required a middleman. However, the "*potential removal of brokers and intermediaries*" (Tanja, 2017, p. 1) is frequently reported, possibly to highlight the potential disruption of the technology. Rather than the elimination of trusted third parties, a change of their role together with a reduction in the necessary amount of committed capital for the settlement process is considered as most likely (Deubel et al., 2017; Rauchs, Blandin, Bear, & McKeon, 2019).

Disintermediation has practical limitations, especially for securities traded on standardised terms over exchanges, as there are several complex interactions between intermediaries in the "post-trade environment" (i.e. in the settlement process after a trade between parties has been agreed upon). These include CCPs; CSDs; clearing and settlement participants; and other agents, such as brokers and custodians. Although direct access to the same DL could eliminate the need for some of these intermediaries or change the nature of their work entirely, some of the functions are unlikely to be replaced. Especially, tasks that require "*discretion or judgement"* (Manning et al., 2016, p. 31), such as the handling of a *"replacement cost guarantee or default management functions of a CCP*" (*ibid.*) will be difficult if not impossible to be replaced by BCt (Manning et al., 2016).

2.3.3 Increase in Settlement Speed

Another frequently observed aspect of BCt business cases is the potential to increase settlement speed. This is because BCt can be used whenever various types of transactions need to be checked and validated in near real time and protected against manipulation with a consensus mechanism, such as proof-of-work (Dapp, 2016). Through the use of BCt in a security transaction, the accounts of both counterparties are updated simultaneously when the transaction is authorised, thereby greatly increasing the speed of transacting. This direct settlement process also reduces the number of mistakes that can occur, thus cutting unnecessary work and time out of the process. Manning et al. (2016) from the Reserve Bank of Australia analysed the role that BCt could play in the securities market. One of their analysed advantages of BCt was a smaller settlement lag. The authors positively confirmed that lags could potentially be reduced from days, in many markets *T*+2, to close to real time. A prerequisite for this was an "*immutable record of securities ownership that can be accessed and maintained using DLT*" (Manning et al., 2016, p. 31).

Similarly, Deubel et al. (2017) confirmed faster execution times in their literature review and Delphi study, where they analysed a test case of Ripple. Ripple is not a Blockchain but a protocol that coordinates disparate ledgers – be they Blockchain or traditional – and updates and consolidates their records, effectively "sending" money from one system to the other, including fiat currencies (Lord et al., 2017). Ripple's first cross-border transaction took 10 seconds, compared to the current two-day settlement process (Guo & Liang, 2016). Transfers are possible between different systems but with great delays and, in some cases, a high transaction cost. Therefore, although the primary motivation and business case driver is to connect existing Blockchain infrastructure to circumvent the necessity of one Blockchain "super-ledger" (Lord et al., 2017), indirectly speed is arguably a strong motivation.

Whilst near-instantaneous settlement may be viable for payments, Van Steenis et al. (2016) dedicated an entire chapter of their research to clarifying that although BCt could provide *T*+0 settlement, there are reasons why this is unlikely to become an industry standard for the settlement of financial securities. In fact, given that technology could already deliver instantaneous settlement these days for various assets, and if there were a business case for real-time settlement, BCt would only be one potential alternative (Van Steenis et al., 2016). Indeed, there are reasons against real-time settlement.

End-of-day netting mechanisms and regulatory rules that still exist in many jurisdictions do not allow for instantaneous settlement, because markets with shorter settlement periods have been found to provide less liquidity and to be prone to greater volatility (Van Steenis et al., 2016). Furthermore, *T*+2 or *T*+3 days provide those institutions responsible for accurately measuring and moving securities in transactions (custodians and banks) with a carry, which means that they earn interest during the delay. In many cases, their operation depends on this revenue (Schneider et al., 2016). In contrast, it is assumed that if these institutions freed themselves from their massively expensive infrastructure, they would happily relinquish this income (Van Steenis et al., 2016). Furthermore, significantly reduced deposit facility rates – even negative ones in several major economies, such as the Euro area since June 2014 (Brandão-Marques, Casiraghi, Gelos, Kamber, & Meeks, 2021) – call into question longer settlement periods to earn an interest.

2.3.4 Increase in Security

BCt relies on cryptography and consequently provides users and regulators with confidence (ASX, 2018). Private keys for each user and product improve data security

(Van Steenis et al., 2016). Given the decentralised network infrastructure, for a cyber-attack to be successful, the ill-meaning would have to change the information in a majority of the network's nodes. Using Bitcoin as an example, for an attacker to alter the database, a reworking of the proof-of-work of the current block and all previous blocks would be required, with a simultaneous catching up with and surpassing of the work of the "*honest nodes*" (Nakamoto, 2008, p. 6).

E. B. Bloomberg (2016) explains that (data) security is limited in the current financial system, since financial functions remain concentrated amongst few "*large, undercapitalized banks or other central hubs"* (E. B. Bloomberg, 2016, p. 1). Thus, just the idea that data spread across many nodes cannot be lost or manipulated would improve trust in the financial intermediation system (Paech, 2016). Indeed, in its report, the International Bank of Settlements states that *"the distributed nature of its design, with the use of multiple synchronised ledgers and multiple processing nodes, has the potential to reduce the risk from a single point-of-failure*" (BIS, 2017, p. 22). Such operational failure of "one point" could occur for a number of reasons, including physical nature, such as disasters (for example, a power shortage, earthquake or terrorist attack), and digital reasons, such as a hacking attack. Security and privacy improvements are also amongst the advantages quoted by experts, attributed to greater protection from "tampering" (i.e. manipulation), since the same information is stored with several nodes across large geographical distances, thus offering better redundancies (Manning et al., 2016; Peter & Moser, 2017). The opposing argument states that many nodes in a system potentially grant attackers many entrance points (BIS, 2017).

Security and higher efficiency are key aspects in known BCt business cases. In an evaluation of Blockchain, Dalal, Yong, and Lewis (2017) posed two questions about the business case concerning the Singapore financial services industry; the first question asked whether BCt would render the financial system "*safer and more efficient by reducing risks and costs, across domestic and cross-border cases*" (Dalal et al., 2017, p. 14). Although BCt has the potential to provide greater security and a more resilient infrastructure of data storage in comparison to the current technology used, the security of a particular Blockchain will depend on its specific set-up. In one survey, experts found that risks underlying BCt, namely technical risks such as hacking and manipulation, were greater than for current systems in place (Deubel et al., 2017). Currently applied cryptography could ultimately be rendered void by future technological advances, for example significant increases of processing power (BIS, 2017).

2.3.5 Greater Transparency/Visibility

The general idea is that BCt can result in increased transparency because internal compliance departments as well as external regulatory bodies could be granted direct access to a Blockchain. It could act as a "*single source of truth*" (Manning et al., 2016, p. 30) and provide direct access to regulators, using the Blockchain and the data stored within, as a "*consolidated audit trail*" (Manning et al., 2016, p. 31), monitoring compliance and assessing systemic risk, potentially to foresee crisis better (Lord et al., 2017; Manning et al., 2016; Van Steenis et al., 2016).

Therefore, for a regulator, a higher level of market transparency and visibility are potential advantages of BCt. Furthermore, BCt is seen as a chance to reduce the work incurred by regulators. It could reduce the need for internal and external audits by directly connecting those departments and authorities to the Blockchain (Deubel et al., 2017). Access throughout the day, 365 days per year arguably increases transparency and visibility. Although this could be possible from a theoretical and technical viewpoint, Pinna and Ruttenberg (2016) point out that this is unlikely in practice, as the Blockchain will likely need to interact with other off-ledger entities that have other and fewer operating hours.

2.3.6 Interoperability and Common Industry Standards

The way in which BCt may shape the industry is another aspect found in the literature. Some claim that all kinds of assets, such as "*money, equities, bonds, titles, deeds, contracts"* (Tapscott & Tapscott, 2017, p. 1) and theoretically any other kind of asset can be held and transferred "*securely, privately and peer to peer"* (*ibid.*) given that the system does not rely on the trust ascribed to a few institutional intermediaries (e.g. banks and governments), but on "*network consensus, cryptography, collaboration and clever code*" (Tapscott & Tapscott, 2017).

However, many disagree with the idea of a universal, all-encompassing Blockchain in the financial services industry, as data is held by incumbents and a transition from the old operating system to such a large-scale new system would bear too high a risk. Given the number of transactions processed by the financial system every second, speed and operational security are two major arguments against a single Blockchain. Rather, the emergence of several specific, privately run Blockchains, operated by partnerships of specialised BCt providers and large financial institutions, is likely (Paech, 2016; Van Steenis et al., 2016).

2.3.7 Risks

The literature contains reports of the potential of BCt to reduce certain types of risks and threats of these in the security settlement industry. Several risks in the process of security settlement can potentially be mitigated. Settlement risk – the risk of one party not fulfilling its contractual obligations at settlement – and essentially all other forms of risk that arise from a time lag between trade execution and settlement can be reduced (Peter & Moser, 2017). Lower risks, both in information reachability and transaction errors, are some of the main advantages of BCt (Peter & Moser, 2017; Rosner & Kang, 2015).

Although BCt serves to reduce risks, it can also create them. Any change from a well-functioning, albeit less efficient system will require parties to adjust their processes and is likely to cause initial errors (Lord et al., 2017). Private Blockchains, where the sponsor or so-called gatekeeper "*holds enormous power*" (Yermack, 2017, p. 12), put all Blockchain participants at risk. This model is contrary to Nakamoto's original motivation, namely to create a system without a trusted third party and the related risks (Nakamoto, 2008; Yermack, 2017).

3 Methodology and Research Approach

We sought to explore why financial institutions implement BCt in their security settlement businesses based on a qualitative analysis of the aspects considered in the underlying business cases. For this inquiry, as stated in Chapter 1, we structured our research according to three research questions: i) What existing models are available to evaluate technology business cases, and how suitable are they to evaluate BCt business cases? ii) Which aspects were considered by financial institutions in their BCt business cases for security settlement? iii) What would a suitable framework to assist practitioners in the implementation of a BCt business case look like? Chapter 2, our literature review, considered a number of technology frameworks as well as aspects of BCt in the security settlement space.

Chapter 3 is organised as follows: In the first two sections, we clarify the philosophical background of our study, rooted in the aims of our inquiry and resulting in our use of a qualitative research approach and grounded theory (GT) as our research methodology. Thereafter, we describe the research sample and our sampling strategy. We subsequently explain the research design, considering data collection and the data analysis methods based on the Glaserian GT approach with a three-tiered coding design. We then turn to ethical considerations and efforts to reduce bias.

Accordingly, we present our findings in Chapter 4 and evaluate them with respect to the applicability of other frameworks for the analysis of BCt business cases in Chapter 5 and with regard to our contextual findings in Chapter 6. We present our framework in Chapter 7 and discuss our evaluation in Chapter 8.

3.1 Research Paradigm and Approach

Following Guba and Lincoln (1994, pp. 110-111), we applied a qualitative research philosophy – more precisely, a constructivist research paradigm. The word “paradigm” has Greek roots (*paradeigma*) and describes the underlying philosophical approach to our research in terms of ontology and epistemology (Maxwell, 2009, pp. 223-224). Ontology is a philosophical concept about the nature of reality (i.e. *what* reality there is to know); epistemology is a philosophical concept about *how* we obtain what there is to know (Guba & Lincoln, 1994, pp. 107-108).

Our decision to adopt a constructivist approach was based on our research interests and goals (Orlikowski & Baroudi, 1991). The term “constructivist” is commonly used to

describe a research approach following constructivism, and the terms “constructivism” and “constructionism” are often used interchangeably (Bryman, 2016, p. 689). We adhered to the definition of Crotty (1998) that “*constructivist*” (i.e. “*constructivism*”) is the “*meaning-making activity of the individual mind*” (Crotty, 1998, p. 58). Here, knowledge is thought to be constructed by the experiences of individuals (Guba & Lincoln, 1994, p. 111).

Indeed, we sought to understand the perceived motivations, risks and other foundational aspects of business cases underlying the implementation of the relatively new and unknown BCt in a business area concerning vast financial magnitude. Given this practical phenomenon, shaped by human decisions, which are subject to a multitude of internal and external influences, in line with our paradigm, our ontology followed relativism and interpretivism (Guba & Lincoln, 1994, p. 109; Orlikowski & Baroudi, 1991). In other words, if asked about *what* there was to know in the first place, our view in this research field is that truths are a result of relative interpretations, constructed by humans, including ours as researchers, within a complex system of reciprocal interactions (*ibid.*).

In contrast, an ontology of positivism would assume that there exists one absolute and objective truth, independent of the involved humans, that can be measured objectively by an independent researcher (*ibid.*). For the complex process of implementing a new technology within an organisation, where decisions are created in a flux of numerous interdependent motivations, constructivism seemed more applicable (Orlikowski & Baroudi, 1991).

Epistemologically, our constructivist paradigm called for interactions between us (the researchers) and experts to yield knowledge, which can be referred to as an inductive and interactive research approach (Maxwell, 2005, pp. 3-10). No theoretical proposition existed which we would have been able to test deductively, as a starting point. Instead, we began our research with a general and, as suggested by Corbin and Strauss (2015, p. 35), open-minded interest in the motivations to implement BCt in the settlement process of financial securities – we sought to recognise patterns within business cases with the aim of constructing meaning whilst collecting data (Lincoln & Denzin, 1994; Myers, 2013, pp. 77-78).

As explained in Section 1.2 above, research on BCt business cases in the space of security settlement appears to be in a pre-paradigmatic stage; this qualitative, open-minded and inductive research approach thus promised to yield new insights. Indeed,

we sought to explore and obtain a thorough understanding of practitioners' perspectives and motives within the industry and role-specific environments. Qualitative research is suitable for such inductive reasoning, where a researcher approaches the given situation with openness and flexibility to discover new and unknown realities (Charmaz, 2014, p. 243; von Bary, Westner, & Strahringer, 2018).

3.2 Grounded Theory Methodology (GTM)

To pursue our research goals and in the light of our philosophical paradigm of constructivism, we sought a suitable qualitative research methodology. Given the explorative nature of our research, which aimed to explore and analyse what was taking place and to build rather than test given concepts (Strauss & Corbin, 1998, p. 223, as cited in Patton, 2014, p. 542), GT proved to be the methodology of choice (Mason, 2002, p. 174; Maxwell, 2009, p. 221).

Considering the foundations of GTM, in 1967, Barney Glaser and Anselm Strauss published their book "*The discovery of grounded theory: strategies for qualitative research*" (B. G. Glaser & Strauss, 1967) and introduced what has since developed into both a research methodology and a set of research methods (Urquhart, 2013, p. 4). Originating from the field of sociology, this explorative methodology introduced a system to interpret human behaviour and methods for developing theories from data. The authors described GTM as a "*style of doing qualitative analysis*" (Strauss, 1987, p. 5) that includes "*the use of a coding paradigm*" (Charmaz, 2014, p. 1) but is otherwise flexible in its use (Charmaz, 2014; Strauss, 1987).

In this sense, GTM is an explorative, inductive and interpretive methodology, consistent with the philosophical foundations of qualitative research in the study of social interactions. Its name is not to be misunderstood – it is not a theory itself but a methodology to analyse qualitative data, offering a number of systematic, iterative procedures and tools which can be applied to explore and explain complex, real-world phenomena about which little understanding exists (Charmaz, 2014, pp. 1-2; Flick, 2009, p. 428; Urquhart, 2013, p. 4). Using a GT design, our aim was to understand, holistically, which key aspects of the encountered phenomenon were considered by the protagonists (i.e. the business practitioners) implementing the BCt business cases in real-world environments, rather than in isolation in an experiment (Bryman, 2016, p. 24; Mason, 2002, p. 167; Maxwell, 2009, p. 221; Patton, 2014, pp. 47,64).

Furthermore, Urquhart (2013, pp. 55-56) emphasises the need to clarify the "role" of GTM in the study design (Urquhart & Fernández, 2016). Regarding our third research question, we aimed to explore what a framework could look like, based on the concepts found in relation to our second research question (Holton, 2008). In the introduction, we delineated a concept as an "*abstract idea"* (Charmaz, 2014, p. 342) and explained our aim to develop a conceptual framework based on the developed concepts, rather than a theoretical framework, which would be based on theory with an expectation to be explanatory and predictive (Imenda, 2014). The goal of developing such a conceptual framework, which would aid practitioners in their work, convinced us that GTM would be the best-suited methodology (Fernandez & Lehmann, 2011; Fernández & Lehmann, 2005; Urquhart, 2013, pp. 8-9; Urquhart & Fernández, 2016).

There are several methodologies within the space of qualitative research for IS. As alternatives to GTM, we dismissed "narrative inquiry" and "action research" because we aimed to explore business cases in depth rather than to tell a story, and we did not want to limit ourselves to a description of what happened (Myers, 2013, pp. 173-174). Given the strict confidentiality of the topic, neither was it our intention, nor would it have been possible to intervene or actively take part in the researched situation beyond the inquiry, as in the case of action research (Myers, 2013, p. 76). As a real alternative to GTM, we carefully considered thematic analysis, following the Framework Approach, which was established by the National Centre for Social Research, UK, with a matrix-based method of themes and sub-themes (Bryman, 2016, p. 585). Although it is increasingly used and also recognised by some as a stand-alone data analysis approach (Bryman, 2016, pp. 584-585) in its origin, it lacks a philosophical paradigm and is arguably more a coding technique used in various qualitative methods than an approach in itself (Urquhart, 2013, p. 39). Given this lack of generally agreed-upon principles, we dismissed thematic analysis to avoid limiting the potential level of abstraction of our analysis (Braun & Clarke, 2006; Bryman, 2016, p. 697; Flick, 2009, p. 439).

3.2.1 Advantages of using GTM

The first and most pertinent reason for our use of GTM, as explained above, was the applicable philosophical paradigm of constructivism. GTM strives to use iterative data collection, analysis and comparison to allow concepts and theory to emerge from the data (Bryman, 2016, p. 381; Charmaz, 2014, pp. 116-117). Such a procedure stands in stark contrast to most other research approaches, where data is collected and one or many theory-based hypotheses are either confirmed or negated (Esteves, Ramos, & Carvalho, 2002).

The second reason that GTM appeared to be the best methodology lies in our second research question regarding which aspects financial institutions considered in their BCt business cases and in our subsequent goal to develop a conceptual framework thereof. The use of GTM to build a framework is widely recognised (Urquhart, 2013, pp. 8-9; Urquhart, Lehmann, & Myers, 2010). In fact, in 2017, Wiesche et al. (2017) from TU München found that out of 43 GTM publications between 1967 and 2013, a large number (42%) established a model, in this context comparable to a framework, rather than building theory (23%) or offering rich descriptions (35%).

The third reason for our use of GTM was our chosen topic of inquiry and the fact that little is known about the motivations underlying the implementation of BCt business cases in the space of financial security settlement. With the potential to explain complex phenomena, GTM is an appropriate methodology for an unknown situation for which relatively little previous research has been conducted (Holton, 2008).

Regarding the question of which aspects financial institutions considered in their business cases to implement BCt for financial security settlement, as shown in our preliminary literature review following Urquhart (2013), previous research is limited to various explanations of the general potentials and advantages of BCt, such as the disintermediation of intermediaries. Given such multi-dimensional decisions made in corporate contexts and influenced by a multitude of factors, GTM seemed ideally suited for an in-depth inquiry, rooted in the findings obtained by those involved in the decision-making and implementation processes.

From its roots, GTM has been seen as a methodology particularly suitable for events that occur within complex, multi-dimensional organisational contexts of a dynamic nature (Orlikowski, 1993). The implementation of BCt is subject not only to such complexities of internal organisational dynamisms but also to external forces, adding further complexity. Therefore, this third criterion ultimately applies to the implementation of any technology, but especially to one as nascent and, by definition, as dependent on interoperation as BCt (Urquhart & Fernández, 2016).

Finally, we chose GTM because, as of today, it is a well-established methodology in the realm of IS. With her seminal paper, Orlikowski (1993), analysed the adoption of CASE (Computer Aided Software Engineering) tools in two organisations. Indeed, the lack of systematic analysis in areas missing existing previous abstraction was one of the

reasons Wanda Orlikowski cited to justify her use of GTM, which was until then an approach confined to the subjects of sociology and psychology (Orlikowski, 1993). In the space of financial security settlement, in our literature review, we were unable to find a systematic model, framework or theory analysing the implementation of BCt or a holistic evaluation of the underlying business cases, further supporting our use of GTM (Urquhart, 2013, p. 10; Urquhart & Fernández, 2016).

3.2.2 Glaserian versus Straussian GTM

In 1990, at the request of his students to provide a how to use GT manual (Urquhart et al., 2010), Anselm Strauss proposed detailed guidelines on how to conduct the data collection and analysis (Strauss & Corbin, 1990, pp. 55-59, as cited in Flick, 2009, p. 307). These guidelines initiated the division of GTM into two schools of thought. With this publication, Strauss triggered a radical divergence from the original idea to allow theory to emerge from data in a flexible way (B. G. Glaser & Strauss, 1967, pp. 48,66,186,209), stating that merely his revised coding paradigm would result in substantial theory. Strauss drastically limited the amount of flexibility allowed for in the data analysis and coding processes, subjecting it to a set of four rigid steps. Interestingly, in his later update, Strauss returned to greater flexibility, with less emphasis placed on strict coding rules (Corbin & Strauss, 1990; Strauss & Corbin, 1998 as cited in Urquhart, 2013, p. 19).

In many ways, the various GT interpretations appear to be similar in the way that text fragments are iteratively and repeatedly compared and analysed in what B. G. Glaser and Strauss (1967) coined "*the constant comparative method of joint coding analysis*" (B. G. Glaser & Strauss, 1967, p. 102) to yield increasingly abstract categories and concepts. Differences in the GTM derivatives appear to be at least partly a matter of nomenclature of the process. For example, Charmaz (2014) refers to open coding as *"initial coding",* and selective coding as *"focused coding"* (Charmaz, 2014, pp. 113-114).

We followed the coding scheme based on B. G. Glaser (1978), as explained by Urquhart (2013, p. 9). One practical difference between the Glaserian and Straussian GTM techniques is the second coding step, namely selective versus axial coding, to abstract the open codes obtained during the first coding step. In the Glaserian version, selective coding is the process of creatively building categories out of open codes before developing theoretical dimensions in the third step. Strauss insisted on adding another layer before selective coding to "dimensionalise" the codes with an element of hypothesising about the elements of codes and categories. Under consideration of various other interpretations and coding procedures, for example by Charmaz (2014),

Strauss (1987) and Corbin and Strauss (1990), we decided to follow the three-stepped Glaserian approach, applying open, selective and theoretical coding, as detailed in our research design below.

Furthermore, the Glaserian approach appealed to us, as it offers a straightforward process with the original degree of flexibility of GTM (Urquhart & Fernández, 2016). In contrast, if we had pursued the Straussian approach, we would arguably have had to adhere to six theoretical codes, which although general, appeared to lack the practicability we were aiming for in our work (Strauss & Corbin, 1990).

In pursuit of answers to our research questions from the depth of our data and to construct a conceptual framework that would be comprehensible by business practitioners, the high flexibility offered by the Glaserian approached seemed appropriate (Charmaz & Belgrave, 2012, p. 347; Urquhart, 2013, p. 25).

3.3 Research Sample

3.3.1 Purposeful Sampling Strategy

Having established and explained our qualitative research approach, we now turn to the employed sampling strategy. Patton (2014) describes qualitative sampling strategies as "*purposeful*", given that the aim is to select samples strategically and purposively to generate "*information-rich cases*" and a deep understanding of a specific situation, rather than to randomise the selection of a large, statistically significant sample size to best represent its population – as is the aim of quantitative research (Bryman, 2016, p. 413; Patton, 2014, p. 308).

Following a categorisation scheme of purposeful sampling strategies (L. Bloomberg, 2007; Patton, 2014, pp. 264-273), our strategy is best described as a **hybrid stratified purposeful sampling** approach because of our combination of sampling strategies. In part, our hybrid strategy consisted of criterion sampling, heterogeneity sampling and theoretical sampling. These three strategies took place in sequence, as illustrated diagrammatically in Figure 9; considered schematically, these three strategies were based on opportunistic sampling and therefore can be described as a hybrid strategy.

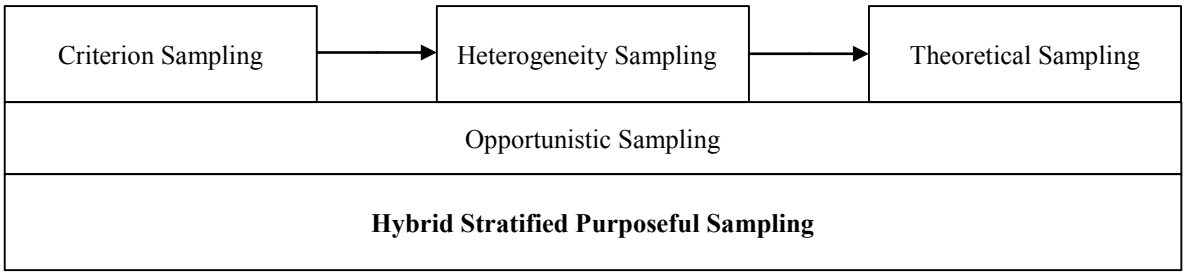

Figure 9 Hybrid stratified purposeful sampling strategy

To start, we pursued a strategy of **criterion sampling**, where we determined a set of criteria to be fulfilled; these criteria defined the potential interviewees with whom we would conduct interviews. These ideas and criteria were devised as part of our research proposal, written in the first half of 2018. Interview participants were to be:

1. From the European-based finance industry,
2. From the functional roles of trade-fulfilment, technology or management departments,
3. From different types (e.g. different sizes and ages) of financial institutions,
4. In possession of expert knowledge on the topic of BCt in the security space and involved in a BCt implementation or with a history thereof.

Embedded in the second and third criteria above, our approach included a **heterogeneity sampling** strategy. Here, the goal is to select participants with widely diverging criteria to capture different viewpoints (Patton, 2014, p. 283). This strategy appeared suitable for our business case focus, given the flexibility, non-standardisation and resulting wide-ranging differences of business cases (Schmidt, 2003). One angle, as stated above, concerned participants' functional roles. Furthermore, we sought to incorporate interviewees who were able to answer questions about the different uses of BCt within the realm of security settlement. We also sought to develop our sample to include interviewees from different types of organisation. We summarise those three angles as follows:

1. Functional role of interviewees;
2. Application of BCt within security settlement;
3. Type of organisation.

Finally, we applied **theoretical sampling**, which is inherent in the roots of GTM, dating back to Glaser and Strauss' original work (B. G. Glaser & Strauss, 1967, pp. 45-48), with later modifications followed by Strauss (Strauss, 1987; Strauss & Corbin, 1990, as cited

in McCann & Clark, 2003; Urquhart et al., 2010). However, the practical applications of theoretical sampling commonly diverge from the original techniques (Mason, 2002, p. 124). We pursued this strategy by sequencing our data collection and analysis so that, where possible, for every interview, we transcribed, coded and analysed our data in turn. We constantly compared our results with theoretical sensitivity and the aim to saturate our categories, selecting later interview candidates to obtain different viewpoints on the subject matter and to achieve theoretical saturation (Dey, 1993, p. 273; Myers, 2013, p. 22).

To some extent, the three aforementioned sampling strategies were based on an element of the **opportunistic sampling strategy**, given the subject matter and limited access to potential gatekeepers. Approximately half of the initially contacted potential interviewees declined to be interviewed given their employment relationship and confidentiality adherences. During the time of conducting our interviews (2019), the statements of contacted professionals suggested that financial institutions were intensively working on the topic of BCt in the space of post-trade activities and that projects had high levels of confidentiality.

3.3.2 Participant Selection

Table 1 summarises the process of contacting potential interviewees, according to our four delimiting criteria: experts from a European-based financial institution; in a management, technology or post-trade role; from various types of institution and experienced in BCt business case implementation. Table 1 includes every contact only once, and the number of interviewees is listed in the fifth column (i.e. “Interviewees” were Tier-1, -2 or -3 contacts not counted in their respective columns). Including eventually interviewed experts, we contacted 46 experts and conducted interviews with 10 of them.

	Tier-1	**Tier-2** “contacts of Tier-1”	**Tier-3** “contacts of Tier-1 or -2” contacts”	**Interviewees**	**Total contacts**
Procedure A “existing network”	17	9	2 (3 interviewed)	3	**31** 67%
Procedure B “cold contacts”	7 (3 interviewed)	1	0 (4 interviewed)	7	**15** 33%
SUM	**24** 52%	**10** 22%	**2** 4%	**10** 22%	**46** 100%

Table 1 Summary of contacted interview participants

Procedure A involved contacting people in our own network, whom we counted as Tier-1 contacts. We asked them to recommend us to professionals who would qualify as interview candidates (i.e. Tier-3 contacts) according to our aforementioned criterion sampling delimitations. If they did not know any Tier-3 contacts, we asked them to refer us to someone whom they thought could potentially refer us to a Tier-3 contact. We refer to these intermediary contacts as Tier-2 contacts.

We contacted 17 Tier-1 contacts in our own network, nine of who referred us to Tier-2 contacts. In the eight other cases, our Tier-1 contacts did not yield any success, either because they did not try to contact anyone; did not know any suitable Tier -2 or -3 contacts; referred us to someone who turned out not to fulfil our criteria; or, as we know was the case in two situations, were told within their organisations that an interview on BCt was impermissible, chiefly due to high confidentiality constraints on this particular subject matter.

Contacting the nine obtained Tier-2 contacts was successful two times and unsuccessful seven times. However one of the successful Tier-2 contacts resulted in two successful Tier-3 interviews so that Procedure A resulted in three interviews.

In **Procedure B**, we reached out directly to Tier-3 contacts (i.e. experts who fulfilled our delimiting criteria), without prior introduction, either at attended conferences or via the social network LinkedIn. In three out of 10 times we conducted interviews directly with contacts.

Moreover, two Tier-1 contacts offered us referrals – in one case, a Tier-2 contact, which was lost, and in the other case, a referral, which eventually resulted in four interviews. The other five contacts were unsuccessful. Procedure B resulted in seven interviews.

Next to IDs and the respective interview lengths, Table 2 provides background to the 10 interviewees we selected for our evaluation. It also lists information about our heterogeneity sampling strategy, specifically, the interviewees' functional roles and the type of organisation they worked for at the time of the interviews.

ID	Functional-role	Type of Organisation	Time hh:mm	Description
I	Senior consultant	Consultancy	00:53	A senior strategy consultant at an international consultancy whom senior management from financial institutions consulted regarding the implementation of BCt and who led Blockchain implementations at international financial institutions.
II	Technical consultant	Consultancy	01:35	A technical consultant for financial institutions and technology providers who was interviewed about the situation at a particular global investment bank that had contracted him as an adviser in implementing a global BCt project.
III	Blockchain product manager	Bank	01:23	A product manager who specialised in DLT in the realm of security trading. He had successfully arranged BCt-based bilateral trades between clients, without the bank acting as a legal counterparty.
IV	C-level representative	Bank	01:23	A senior management representative and head of DLT in a bank's research lab. Since the initiation of the incubator, this individual had overseen 12 BCt business cases.
V	Crypto strategist	Bank	00:45	An investment banker with a leading international investment bank, advising on BCt projects and managing crypto portfolio strategies.
VI	CIO (product development)	Fintech	00:52	A former investment banker, specialised in asset management and experienced in corporate and regulatory activities. At the time of interview, he was an entrepreneur in the Blockchain space for over five years.
VII	CCO (compliance)	Fintech	00:44	A legal professional, specialised in corporate and regulatory law. This interviewee was experienced in regulatory matters and responsible for regulation, compliance and product management at a BCt start-up.
VIII	CTO (technology)	Fintech	00:37	A senior architect with long-standing experience in software development at large organisations. At the time of the interview, this person was responsible for the development team that was building a Blockchain tokenisation platform.
IX	COO (operations)	Fintech	00:44	A senior manager with a background in corporate DLT projects, responsible for BCt product development and procedural administrative work in the building of a BCt-based issuance and settlement platform.
X	Director	Regulator	01:19	Head of the regulatory body of the financial authority of a sovereign state. Responsible for the drafting, issuance, consultation and amendment process of the jurisdiction's first Blockchain legislation.
Note: BCt = Blockchain technology; DLT = distributed ledger technology				

Table 2 Summary of interviewees, organisations and description

3.4 Research Design

After explaining our underlying research approach and methodology, including a detailed explanation of our sampling strategy and research sample, we now turn to a step-by-step explanation of how we carried out the study. Both our data collection and analysis were based on GT methods and accordingly took place iteratively. To establish a new conceptual framework, we compared new findings (i.e. codes) with existing ones to develop and saturate our categories and refine our concepts. In line with our constructivist philosophical paradigm, we followed the Glaserian coding approach with three coding stages, as originally introduced by B. G. Glaser and Strauss (1967) and further detailed by B. G. Glaser (1978).

The various sub-sections of the following section repeatedly refer to Figure 10, which is based on the Glaserian GTM (B. G. Glaser, 1978; Urquhart, 2013, pp. 45-50) and is a graphical adaptation from Way and Yuan (2017).

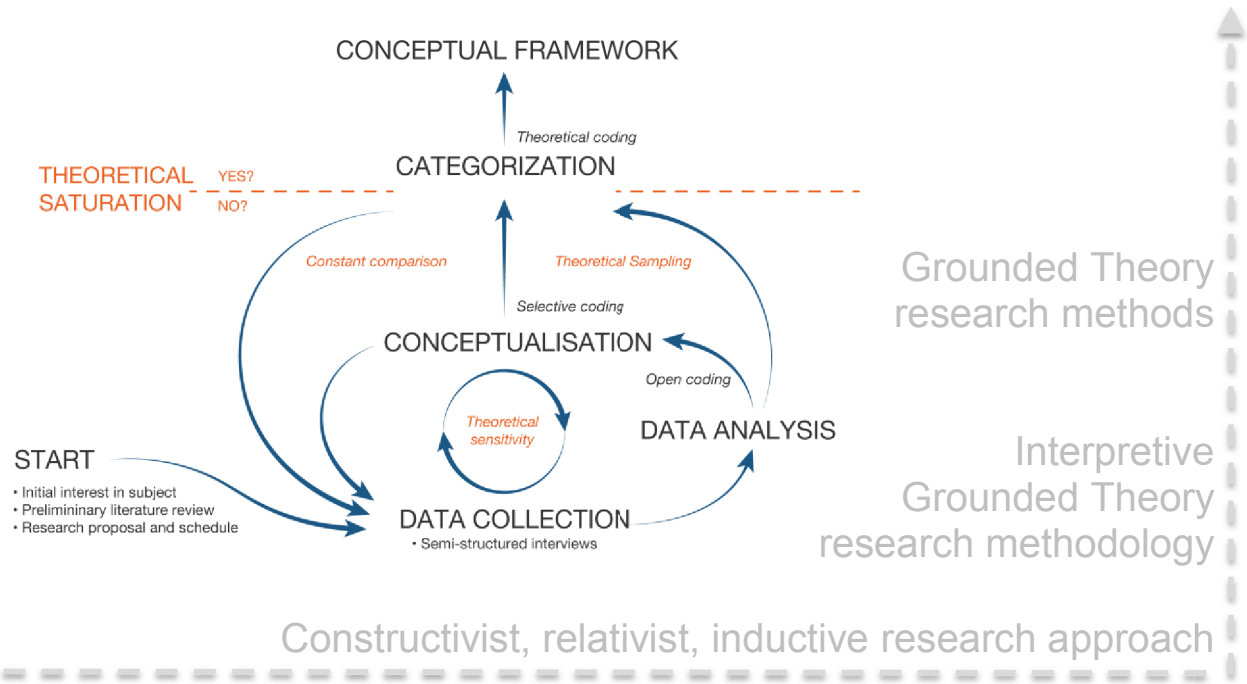

Figure 10 Constant comparative theoretical sampling research design based on Way and Yuan (2017), Glaserian GTM (B. Glaser, 1978; Urquhart, 2012, pp. 45-50)

Start: Preliminary Literature Review, Research Proposal and Schedule

Our initial interest in BCt in the realm of financial security settlement motivated our preliminary literature review. Here, the aim was to acquaint ourselves with the topic whilst avoiding preconceptions from existing knowledge (Charmaz, 2014, p. 306). Our aim was to gain a more detailed understanding about the subject's background and to clarify the

value of this inquiry (McCann & Clark, 2003). In particular, the review was important for us to become familiar with existing concepts in the chosen field of research – an idea referred to as theoretical sensitivity, first introduced by B. G. Glaser (1978) – whilst maintaining a theory-neutral position prior to conducting our GT data analysis (Suddaby, 2006; Urquhart, 2013, p. 16). As part of our analysis of our findings in Chapter 6, we then returned to the literature, comparing and contrasting it with our findings.

We embedded our preliminary literature review in a research proposal. In the process of writing our proposal, we developed our central research problem and research goals (Section 1.3, page 7). Furthermore, the proposal included a letter of introduction; a confidentiality and non-disclosure agreement (NDA); a first version of our interview questions, following (Myers, 2013, p. 131); and a schedule of the planned research activities. The letter of introduction, NDA, schedule of data collection activities and interview questions are included in the appendix, starting on page 201. We finalised and submitted the proposal, which was subsequently reviewed by the chair of our department in October 2018. Our data collection activities were scheduled and commenced in December 2018 with the contacting of our Tier-1 contacts.

Data Collection: Semi-Structured Expert Interviews and the Interview Questionnaire

In line with our constructivist research paradigm, we chose semi-structured expert interviews with guiding interview questions to obtain detailed and rich information about the procedure of the business case implementation, based on the views and experiences of the interviewed experts (Flick, 2009, pp. 156-169). We developed our interview questions (Appendix 10.4, page 205) with the primary aim to answer our second research question regarding which key aspects were considered in business cases to implement BCt for the security settlement.

We developed our interview questions in line with GTM, giving the topic of BCt and business cases some thought without substantial preconceptions and with an "*open mind*" (Dey, 1993, p. 65). Accordingly, we thought of important topics that would be involved in the chronological process of a business case (Maes et al., 2014).

The questionnaire was structured in five thematic parts. It was based on our existing understanding of the subject matter, which we augmented with our preliminary literature review and our aim to fill the identified research gap (i.e. no existing conceptual framework to analyse Blockchain business cases). Furthermore, the questionnaire followed specific existing business case literature, breaking down a business case into

distinct phases in line with a chronological process perspective (Maes et al., 2014; Messner, 2013, pp. 73-78).

In the first part, we inquired about the **pre-execution** phase, also known as the planning or pre-implementation phase of the business case. In addition to factual information, such as the starting year and applied financial calculations, we also inquired about the circumstances resulting in the interest and decision to establish a BCt business case, challenges in doing so and the organisational processes to establish the business case.

In the second part, following Ward et al. (2008) (as cited in Nielsen et al., 2019), we focused on the **content** of the specific BCt business case. Amongst other things, we asked about the motivations of the business case, assumptions that were made in the process of establishing the content as well as risks, objectives and other factors that were considered as part of the business case. Furthermore, we inquired about the approval process and how, if at all, the content of the business case was altered during this stage.

The third part of the interview questions concentrated on the **execution** of the business case in comparison to other business cases of the organisation, or other business cases the experts had experience with. In this part, we inquired about the various stakeholders involved in the business case and how they interacted to execute it. This part also considered any significant internal and external events and how the business case evolved during its execution.

The fourth section considered aspects of the business case **evaluation**, which is a common area of concern in business case literature (Messner, 2013, p. 76), chronologically considered after implementation (Maes et al., 2014). Questions in this area related to the nature of the evaluation, for example what the internal corporate procedures versus external regulatory requirements were, who conducted the evaluation and how it took place. Furthermore, other questions aimed to trigger a reflection on the particular business case, such as its success and the encountered challenges.

As closing questions, following Charmaz and Belgrave (2012), in the fifth and final part of the questionnaire, we invoked a more general discussion. We asked about how BCt had already impacted the settlement of financial securities and about the expectations of how it will impact this particular area and the financial services industry.

We mixed shorter questions to obtain facts about the business cases and longer conversational questions aimed at triggering descriptions of the memories and experiences of the experts to obtain rich data, suitable for GT analysis of the process of the BCt business case implementation (DeMarrais, 2004, pp. 62-63). Based on the methodological idea of open-mindedness (Corbin & Strauss, 2015; Dey, 1993, p. 65), to avoid influencing the interviewees' answers, we paid particular attention to our language when asking the questions (Charmaz & Belgrave, 2012, p. 350). We sought to cover a large spectrum of topics whilst obtaining sufficient amounts of detail to analyse interview candidates' experiences in detail (Myers, 2013, pp. 131-132).

Meuser and Nagel (1989), as cited in and supported by Flick (2009, p. 165), consider an expert interview to be a sub-set of semi-structured interviews. Expert opinions are commonly recognised as a research method (Harrell & Bradley, 2009; Myers & Newman, 2007; Wieringa, 2013), specifically in the area of IS (Myers & Newman, 2007; Urquhart & Fernández, 2016).

In many studies, "experts" are generally described as people with "experience" in a specific subject matter; the question of who is considered "an expert" should be discussed, at least briefly. We followed Flick (2009, p. 166) and considered experts to be those who were involved in and possessed competencies in and experience with BCt. Furthermore, their experience had to be based in a professional setting and be of a practical nature. Following Meuser and Nagel (1989), we did not consider individual biographies but selected potential interview candidates based on their function as representatives and gatekeepers of information on BCt-related business cases (Bogner & Menz, 2009, pp. 17-19; Flick, 2009, pp. 165-166; Meuser & Nagel, 1989, pp. 3-4; von Bary et al., 2018).

Seven interviews were conducted on site at the participants' organisations, in Frankfurt and London. In two cases (ID II and X in Table 2 above), the interviews were conducted via phone. The first interview was held in February 2019 with a consultant for financial institutions.

It was a test interview, often referred to as a "pilot", as recommended for interview questions. The benefits of a pilot are, for example that it enables a researcher to gain experience in conducting the interview, identify misunderstood and redundant questions and test how well the interview "flows" (Bryman, 2016, p. 260). Three questions turned out to ask for almost identical content, and we thus excluded them from subsequent

interviews. Otherwise, the feedback was positive, and the answers to the test interview turned out to be valuable; therefore, we included them in our results.

Comparing a structured interview with an unstructured one, in the former, the questions are adhered to strictly, without the possibility to discuss additional questions, whereas in the latter, there are no pre-formulated questions at all, and the researcher comes up with questions spontaneously in the course of the conversation (Harrell & Bradley, 2009). We decided to apply a semi-structured interview technique to reduce the risk of missing out certain aspects that we wanted to collect data about in all interviews and to guide the conversation. At the same time, we wanted to create a conversational atmosphere to obtain detailed answers and allow for follow-up questions by the researcher (Myers & Newman, 2007).

Despite existing limitations, we found semi-structured expert interviews to be the most suitable data collection method for our purposes. Not only is the issue in question complex and new, but also the answers to our qualitative questions, inquiring, for example about “why” BCt was being implemented, “what” challenges were encountered and “how” the process was carried out, could almost exclusively be found amongst experts (Gregor, 2006).

Indeed, such an in-depth inquiry and revelation of otherwise unavailable so-called “*process knowledge*” (Flick, 2009, p. 167) is one of the keys strength of the semi-structured expert interview data collection method. Weaknesses concerning the inherent subjectivity of the sample selection process were mitigated by adhering to a systematic procedure and a clear definition of who qualified as an expert, as explained above (Flick, 2009, p. 169; von Bary et al., 2018).

Following Bogner and Menz (2009) argument of a “*theory-generating expert interview*” (Flick, 2009, p. 166), we consider the use of interviews as a stand-alone data collection method to be appropriate and in fact the most suitable approach to obtain a high level of abstraction in this new area of research, with a limited amount of accessible data (Flick, 2009, p. 168; Mandják, Simon, & Szalkai, 2011; Ryschka, Tonn, Ha, & Bick, 2014).

Data Analysis and **Conceptualisation:** *Open Coding*

Almost inherent in the history and development of GTM, the terminology for the various steps applied by different authors does not adhere to a definite standard. Following GT methods, mainly according to B. G. Glaser and Strauss (1967) and B. G. Glaser (1978),

this first stage of coding is often referred to as *open coding* and describes the iterative, recurring analysis, comparison and conceptualising of data in so-called open codes (Bryman, 2016, p. 573). Conceptualisation, in a general sense, as illustrated in Figure 10, page 41, takes place during all coding stages and is not confined to the development of “concepts”.

For our data analysis, during 2019, we repeatedly conducted interviews, which we then transcribed and coded. We recorded the interviews using a mobile phone set on airplane mode, with sufficient power supply and the voice recording application AVR. We subsequently transcribed each interview verbatim, employing the transcription tool AmberScript, and we coded the transcription following Urquhart et al. (2010), as detailed below, using the qualitative analysis tool NVIVO. The transcription and coding of the interviews took place sequentially, such that the transcription, coding, conceptualisation and adjustment of code categories was completed, where possible, before the same process was repeated for the next interview.

We used an inductive and flexible open coding style, line by line, during the first interviews but predominantly incident by incident thereafter to break up the text, analyse and assign existing labels to text fragments and develop new ones where necessary and appropriate (Charmaz, 2014, p. 127; Corbin & Strauss, 2015). Table 3 lists two interview answers to our interview question number 11. b), regarding what motivated the use of BCt.

	Open coding	***Selective coding***		***Theoretical coding***
Interview extract	Open codes	Categories	Concepts	Dimensions
*"Sure it's actually to make the **issuance**. From the primary perspective, you have one main reason, which is **making issuance cheaper**. **Issuance are expensive and complex**. Blockchain is a nice part of our tech – it's not the only part of our tech – we're **automating legal documents**; we have legal documents templates – so we definitely can take a proper, fully recognised issuance, **compliant with regulation** and issued in **half an hour** it takes you to fill a form".* INTERVIEWEE (VIII)	Issuance of native assets	Primary issuance	Use of BCt	**Application Area**
	Easier, cheaper issuance Process automation	Greater operational efficiency	Cost reduction	**Goals**
	Regulatory demands	Reg. environment	External Environment	**Environment**
	Faster process	Increasing settlement speed	Settlement speed	**Goals**
*"Yeah. Very easy. I think two points: First point, is of course, if you can do this at most while the technology itself at **least highly automated**, then there's **a cost saving** case. But that wasn't the biggest **rationale behind** it, as far as I guess, because what we actually looked at were **opportunity costs**, and so we can say, okay, I think it's an advantage that OUR BANK in this case **doesn't have the highest technology** right now at the running systems and that it's **not such a big player** in this business. So we pretty much know that **there will be market development** with or without us. If the technology is coming**, it's not depending on whether OUR BANK** likes it. So it's coming either way. So the only question you could ask yourself is, do you want to participate or not. And so we could argue **participating is better than not**".* INTERVIEWEE (III)	Process automation	Greater operational efficiency	Cost reduction	**Goals**
	Cost saving	Cost reduction of settlement		
	Business case strategy Opportunity cost	Maintaining competitiveness	Competitive-ness	
	Market benchmarking Comparison to comps. Industry development	Market monitoring	Market environment	
	Strategic tech. position	Competitor risk	Strategic risk	**Risks**
	Participation in trend	Public relations		

High

Level of conceptual abstraction

Low

Table 3 Example of coding process

Categorisation: *Selective Coding*, *Constant Comparison*, *Theoretical Sampling*, *Theoretical Sensitivity* and *Theoretical Saturation*

Selective coding is the next stage of coding where a tripartite interplay of *constant comparison, theoretical sampling* and *theoretical sensitivity* is conducted until theoretical saturation is achieved (Urquhart, 2013, p. 24). As represented in Figure 10, page 41, these elements are circular and interdependent. We will consider each in turn.

During this selective coding stage part, we immersed ourselves in the data (McCann & Clark, 2003), constantly comparing codes and developing them into categories and concepts, as presented in Table 3, for two examples. Some authors refer to concepts as "*core categories"* (B. G. Glaser, 1978, p. 93) or "*core variables"* (Urquhart, 2013, p. 49). We developed concepts from frequently reoccurring open codes either by assigning open codes to existing categories, and these to concepts, where appropriate; by creating new ones or by merging existing ones, based on our ever further conceptual comprehension of the various relationships we discovered to be prevalent in BCt business cases (Urquhart, 2013). In that sense, we were not only scaling our categories to a higher level of abstraction by saturating them but also honing our theoretical sensitivity regarding which categories were sufficiently saturated and which ones were not, in a constantly comparative process (*ibid.* 49-50).

To support this process, we frequently took informal notes of our ideas, often referred to as memos, which helped us to understand the meanings of the categories and concepts (Urquhart, 2013, p. 71). The tables in which we present our findings in Chapter 4 and analytical evaluation in Chapter 6 are the synthesis of our memos for each of the categories and concepts (Urquhart & Fernández, 2016; Urquhart et al., 2010).

Constant comparison is the process where coded text fragments within and between different categories are continuously being compared with one another; constant comparison is the key to developing concepts (Bryman, 2016, p. 573; Strauss, 1987, p. 5; Urquhart & Fernández, 2016). In our case, this took place in the form of our iterative and interrelated open and selective coding, data collection, analysis and conceptualisation, during which we compared codes and categories.

At the same time, unsaturated categories guided us in the search for further interviewees, theoretically sampled from either different functional roles or varying types

of organisations, to obtain different perspectives to answer our questions and achieve theoretical saturation (Strauss & Corbin, 1990, p. 96, as cited in Bryman, 2016, p. 573).

***Theoretical sampling**,* as explained as part of our sampling strategy in Section 3.3, is the ongoing sampling process in which the already emerged and developed categories and concepts are used until the goal of theoretical saturation is achieved. In our case, we conducted interviews until no new aspects could be found within the existing categories; that is, theoretical saturation was achieved (Bryman, 2016, pp. 410-411; Charmaz, 2014, p. 192; B. G. Glaser, 1978, pp. 52-53, as cited in Urquhart et al., 2010).

Theoretical sensitivity can be described as the perceptive process in conceptualisation, constant comparison and theoretical sampling, where a higher level of abstraction is developed from the data to determine when theoretical saturation has been achieved. It requires careful consideration of the subtleties of the data (B. G. Glaser, 1978, p. 72, as cited in McCann & Clark, 2003).

Theoretical saturation in GT is "*The criterion for judging when to stop sampling the different groups pertinent to a category […]. Saturation means that no additional data are being found […]*" (B. G. Glaser & Strauss, 1967, p. 61). Theoretical saturation is deeply related to GT and occurs when new data is in line with already given findings and thereby adheres to the established framework of created categories and concepts (Charmaz, 2014, p. 192; Way & Yuan, 2017). Saturation is often confused with a repetition of described occurrences; however, it is much more a repetition of abstract aspects, defining specific concepts such that saturation is unrelated to the size of the sample (Charmaz, 2014, pp. 213-214; Hennink, Kaiser, & Marconi, 2017). To reach saturation, for example, we adjusted follow-up questions to potentially trigger new viewpoints in the light of our obtained understanding and the concepts already established from previous interviews (Froschauer & Lueger, 2009, p. 225).

Amongst grounded theorists, the saturation of categories is more important than sample size, which may be small (Charmaz, 2014, p. 214). The sample size is ultimately determined by the iterative, reciprocal interplay between theoretical saturation and theoretical sampling (Hennink et al., 2017). Indeed, after we conducted, transcribed and coded the first five interviews and it was possible to assign our codes to our established concepts, we applied the concept of theoretical sampling to find interview partners from the same niche of the industry but most likely with a different angle and experience with BCt business cases.

We achieved this by sampling from yet another type of financial institution to find a fintech start-up instead of a large corporate bank or consultancy thereof. We paid particular attention to sampling various different functional roles to obtain potentially deviating "*slices of data […]*" sampling "*[…] along an emergent storyline, deciding on analytical grounds where to sample from next"* (B. G. Glaser & Strauss, 1967, p. 65).

By our ninth interview, we had not found any new categories, and our concepts thus seemed fully saturated. We conducted one more interview, once again sampling from another "*view or vantage point*" (B. G. Glaser & Strauss, 1967, p. 65), namely financial regulation of BCt, to find an expert who had been in charge of writing the Blockchain legislation for the financial regulatory body of an independent jurisdiction. As part of this process, this expert had been required to consider a number of BCt business cases concerning financial security settlement. All the data we obtained from this 10th interview could be conceptually included in our then-established structure of concepts, and we hence concluded that we had reached theoretical saturation (Hennink et al., 2017; Marshall, Cardon, Poddar, & Fontenot, 2013; Morse, 2000).

In hindsight, this theoretical saturation with a relatively small sample size, after interviewing 10 experts, was possible because of a number of combined factors. Our specific research interest in BCt business cases in the settlement process of financial securities is likely to have been a contributing factor. This, in combination with our purposeful sampling strategy of selecting some experts who themselves brought their own experiences of various business cases, allowed us to obtain "*information-rich*" answers, which consequently yielded deep insights during the GT coding process (Hennink et al., 2017, p. 591; Patton, 2014, p. 313).

Working Towards a Conceptual Framework: ***Theoretical Coding***

In the third and final coding part, called *theoretical coding*, the aim is to synthesise and relate open codes, categories and concepts to one another. There are generally three sources of relationships: categories and concepts themselves, ideas from other literature and general theoretical codes that have been suggested over the decades of the GTM (Urquhart, 2013, p. 50).

As seen in the example in Table 3, page 47, for the goals dimension, concepts such as "cost reduction" connected categories such as "greater operational efficiencies" and "maintaining competitiveness". In developing the dimensions from our findings in

Chapter 6, we considered existing literature to then relate these dimensions with one another, as part of building our conceptual framework in Chapter 7 (B. G. Glaser, 1978, pp. 72-73).

Lastly, similarly to other prominent GTM authors, Glaser provides six theoretical codes (B. G. Glaser, 1978, p. 74). Although they are general in nature, we consider them to be somewhat contradictory to the idea of an inductive, exploratory approach, in which the subject matter should be addressed with as few preconceptions as possible (Charmaz, 2014, p. 155). It is certainly acceptable and common to develop one's own theoretical codes, frequently referred to as dimensions, to establish a framework thereof (Urquhart, 2013, pp. 108-109).

3.5 Ethical Considerations

Any research involving people faces ethical considerations (Yin, 2018, pp. 88-89). Given that our inquiry concerns non-personal, professional matters only, we safeguarded the protection of human subjects by ensuring their informed consent to be interviewed, to be recorded and for the recordings to be transcribed and analysed for the purpose of research in relation to BCt and security settlement only (Patton, 2014, p. 496; Yin, 2018, pp. 88-89).

To gain informed consent and protect the privacy and confidentiality of our interviewees, we prepared a confidentiality agreement and NDA (Appendix 10.2) based on a template by Nolen (2018). At the point of initial contact – either in person, for example at a conference; during the first phone call; or in an introductory electronic message – we communicated the purpose of our research as well as the confidentiality and anonymity of both participants' and their organisations' names throughout all steps of our research, and we offered to sign an NDA. To ensure confidentiality, when interviewees mentioned their institutions' name during the interview, we replaced it with the capitalised "BANK". We refer to the interviewees according to their identification codes (IDs), as assigned in Table 2, page 40.

Two interviewees asked us to sign and return an NDA binding us to use the obtained information and material solely for the purpose of research in conjunction with this dissertation and not to mention any names of the interviewees or their organisations. Independently of this, in all cases, we obtained oral informed consent to voice record and analyse the entire interview, either prior to the interview, in the process of scheduling the meeting or shortly before the actual interview. We ensured that the recorded data

was stored safely, limited the number of cloud services to process the recordings to one (AmberScript) and ensured that the service also took cautionary measures to ensure data protection. All data in relation to the research was stored locally and was only accessible by us.

3.6 Issues of Trustworthiness and Authenticity

In this section, we consider potential limitations and biases inherent in our methodology that may have occurred in conducting our research. We follow Lincoln and Guba (1985) (as cited in Bryman, 2016, pp. 384-386), who established two criteria for naturalistic research, trustworthiness and authenticity, as well as M. B. Miles and Huberman (1994), who have provided a number of useful queries in the assessment of these. Trustworthiness and authenticity are alternatives to the commonly used criteria of reliability and validity in quantitative research. Almost by definition, these do not apply to qualitative research, since qualitative research does not focus on measuring data (Bryman, 2016, p. 384). Instead, trustworthiness and authenticity, each with a set of criteria, are more applicable and are explained below in relation to our inquiry.

3.6.1 Trustworthiness

Credibility refers to the extent to which our inquiry and hence our research design as a whole, including its purpose and research questions, its applied methods and resulting findings can be trusted and make sense (M. B. Miles & Huberman, 1994). First, by adhering to the procedures of GTM and collecting so-called "*thick descriptions"* (Geertz, 1973, p. 10) we ensured a basis of credibility (M. B. Miles & Huberman, 1994). Second, we ensured credibility by collecting our data from experts, each of whom worked for respected organisations. Furthermore, we applied our own experience to judge how knowledgeable interviewees were on the subject matter; in fact, one interview was terminated because, in agreement with the interviewee, it turned out that they did not possess sufficiently specific knowledge to answer our questions, despite having worked in the field for over three years.

Third, we used triangulation of data sources (Norman K. Denzin (1970), as cited in Bryman, 2016, p. 384; Patton, 2014, p. 555), in the form of different perspectives provided by interview participants sampled from different backgrounds (e.g. financial institutions, independent consultancies and legal agencies) as well as different functional roles within their organisations (e.g. technology, product development and compliance). Finally, credibility was enhanced through ongoing discussions of our research methods and reviews of all steps, from data collection to analysis of our findings, with our supervisor; also, by conducting follow-up conversations with the interviewees, we

ensured that our conclusions are credible and of practical relevance (Myers, 2013, p. 120; Patton, 2014, pp. 670,653).

Transferability refers to the applicability and generalisability of our research findings to a wider context (M. B. Miles & Huberman, 1994). As with almost any research inquiry – qualitative or quantitative – this is a challenge, since most research, including ours, imposes delimitations to focus on a specific inquiry. Any generalisation is likely to be limited, or as Lincoln and Guba even titled a chapter, "*The Only Generalization Is There Is No Generalization*" because the meaning of anything will ultimately depend on its context (Lincoln & Guba, 1985, p. 110).

Our delimitations were the topic of BCt in the area of security settlement and the business cases constructed to implement BCt. Furthermore, we limited our data collection to experts in the European region and collected our data in a relatively short time frame of 12 months to capture comparable findings regarding a technology that is subject to rapid development. By describing our sample of interviewees in Section 3.3.2 and Table 2, page 40, we allow for the possibility to compare our sample with samples used in other research (M. B. Miles & Huberman, 1994).

Although our work may therefore be criticised for its limited transferability to other geographic regions or the state of affairs at the point of publication, we deemed such a focus to be necessary to provide as "*thick* [a] *description*" (Geertz, 1973, pp. 3-33) as possible. This is a commonly recognised idea to cure the transferability conundrum; detailed descriptions allow readers to judge whether the findings are applicable to other situations, such as BCt implementation in a different setting or possibly even the implementation of a different technology in the setting of security settlement (Flick, 2009, p. 395).

Almost any information technology is subject to rapid development, and although we tried to minimise the delay between data collection and the finalisation of our research, it is unavoidable given the laborious nature of academic work (Bryman, 2016, p. 384; Patton, 2014, pp. 584-587). By cross-referencing our findings with existing findings in our analysis, we ensured a level of congruency with existing research, and given the description of our study design, we consider it possible to replicate our study easily to test congruency with future research (M. B. Miles & Huberman, 1994).

Dependability, refers to the question whether steps of the research have been carried out conscientiously and consistently over time (M. B. Miles & Huberman, 1994). We warranted dependability by formulating a set of clear research questions and collecting our data from a range of settings (M. B. Miles & Huberman, 1994), selecting BCt experts from different professions (e.g. consulting and banking), different geographical locations (e.g. London and Frankfurt) in different corporate settings (e.g. corporations and young enterprises). We were not only conscious about parallelism across the various interviews but also across data sources, comparing and contrasting our findings with existing literature in our data analysis (*ibid.)*.

We also allow for an audit of our research as advocated by Lincoln and Guba (1985), providing raw data of our research, such as the interview transcripts that were created during the research process (Flick, 2009, pp. 392-393). Furthermore, dependability was improved through our ongoing discussions about the procedures and inferences of the inquiry with related academics (Bryman, 2016, p. 392).

Arguably, we created a further mechanism of dependability by presenting our key conclusions and our new conceptual framework to practitioners. This feedback was useful because it supported not only the content of our research but also its applicability at a later point in time, two years after having collected our data (M. B. Miles & Huberman, 1994).

Confirmability concerns the biases inherent in us as researchers, our awareness and explicitness about these biases (M. B. Miles & Huberman, 1994). It thus addresses the question of whether our results are based on the participants and the given circumstances rather than on us (Guba & Lincoln (1981) as cited in M. B. Miles & Huberman, 1994). Our past experiences from the financial industry, prior knowledge on the subject of BCt and ideas obtained during the course of conducting and analysing the interviews inevitably created a bias.

Although "*complete objectivity is impossible in social research"* (Bryman, 2016, p. 386), we were aware of our own potential biases, seeking to mitigate them by conducting all of the interviews in a consistent manner (M. B. Miles & Huberman, 1994, p. 278). Furthermore, with the detailed description of our method in this chapter, we sought to provide transparent insight into our research process and the procedures we used to collect and process the obtained information (*ibid.*). Both in our findings and in our analysis thereof in Chapters 4 and Chapter 6, respectively, we endeavoured to link our

findings and conclusions as closely as possible to the source of the data (i.e. our interviews) (*ibid.*). Finally, we include the original interview transcripts electronically for review by others (*ibid.*).

3.6.2 Authenticity

Beyond trustworthiness, Lincoln and Guba (1985) recommend that research should be assessed on the basis of its authenticity, which refers to abstract ethical ideas. For example, criteria of authenticity consider the fair presentation of different perspectives in an argument, the way in which research has contributed to a better understanding of the topic and how it motivates and empowers individuals to take action (Bryman, 2016). Inevitable human subjectivity, which is an element of almost any qualitative research, poses a limitation to our research as well. We were aware and reflective of this potential subjectivity and possible consequential biases during all steps of the inquiry. We were conscious not to allow our own prior experiences, understandings and ideas to influence any parts of the research findings and/or evaluation.

We sought to carry out our research in a fair manner, representing the viewpoints of all stakeholders as equally as possible (Lincoln & Guba, 1985, 1989, 2009); we ensured ontological and educative authenticity by heightening our awareness of the professional and often confidentially sensitive surrounding in which we collected our findings, whilst sharing and contributing our own knowledge. Beyond this, we believe that catalytic and tactical authenticity was attained during the data collection phase; it prompted the interviewees and future practitioners alike to consider new aspects, and it has the potential to equip other stakeholders with a better understanding of and a greater impetus to improve the status-quo (Bryman, 2016, p. 386; Lincoln & Guba, 1989, pp. 180-181).

4 Findings

The purpose of our research, utilising a qualitative research approach, was to discover why financial institutions implement BCt in their security settlement businesses by analysing which aspects were considered in their business cases. We hope that the gained insights will contribute towards the understanding of this phenomenon and thereby assist practitioners to implement existing and future BCt business cases in this area. In Chapter 1, we outlined the background of our research, explained that BCt is being implemented in the security settlement of financial institutions and shared our motivation to understand the considerations based on the underlying business cases. We formulated three research questions. In Chapter 2, we considered the existing literature. Thereafter, in Chapter 3, we detailed the coding procedure following the Glaserian GT procedures.

Chapter 4 now presents our findings, using the highest level of abstraction, namely our dimensions, as chapter sections. In each section, we use a table to summarise our findings based on the categories and concepts that emerged in our open and selective coding process. In doing so, we amalgamate our open codes and informal memos into descriptive categories. Based on these findings, we will then answer our research questions in Chapters 5 to 7. We refrain from any detailed explanations at this point – they are an essential part of our evaluation in Chapter 6.

4.1 Application Area

In this section and Table 4, we present our findings on and descriptions of the use of BCt in the business cases, as well as the underlying advantages and assumptions.

Concepts	**Categories**
Use of BCt	• **Bilateral security settlement** between transaction parties • Optimisation of **internal settlement** processes • **Primary issuance** of assets • **Secondary trading platform**
Description	• **Dematerialisation of securities** on-ledger to facilitate trading and settlement activities within a Blockchain network • On-ledger, **internal, security-specific documentation and risk management** • **Tokenisation of equity** of companies without prior free-float • **Creation of a platform** to trade the issued equity in token form
Advantages	• **Higher transaction speed** based on a reduction of intermediaries • **Faster internal settlement** based on smart-contract-based computations

	• **Standardised, automated procedures** with fewer process steps • An **immutable single point of reference**
Assumptions	• Ability to **understand the subject matter** is given or obtainable • **Cost savings** can be materialised • BCt is **scalable** • **A market exists** for a BCt-based solution • **Approval for the BCt-based application** can be obtained

Table 4 Summarised findings: Application area

4.1.1 Use of Blockchain Technology

Amongst the analysed business cases that were referred to us by our 10 interview partners, we found a number of different application areas for BCt in the settlement space: *"Settlement is certainly the most obvious business case*" (I). In this business case, the reference concerns the bilateral settlement of securities between different transacting parties: "*this is – you are saving free three days*" (V). Another application area was found to exist within, rather than between, organisations. Here, BCt was employed to optimise internal settlement processes with the aim to improve risk management and control, using a "*network topology to understand risks better*" (II).

We identified two further application areas where BCt was used, first to conduct primary issuance of assets and subsequently, to establish a trading platform for those issued assets: "[…] *it is a cheaper, faster way to promote equity issuance and eventually secondary trading*" (VIII). These application areas are related to security settlement because the main benefits from BCt-based primary issuance and secondary trading derive from the settlement process, as will be explained in our later evaluation: "[…] *because it's scalable technology. Hundreds, hundreds of companies can come through the platform very quickly and very fast, onboarding of both issuers and investors*" (VI).

4.1.2 Description

One interviewee described the application area of bilateral security settlement between organisations succinctly: "*[…] we had a purely digital security, so it wasn't tokenised; it was issued digitally. So it was 'dematerialised'"* (III). In this case, a technical swap of digital cash, a "*euro on-ledger – DLT – no coins, simply Euro"* (III) and a digital form of a security was performed between two parties, and the transaction was recorded on a proprietary Blockchain network. The security was a European commercial paper, which is a debt certificate, and it was traded between two German corporates, both of which were part of the German primary stock index, DAX, at the time.

For the application area, which we refer to as optimisation of internal settlement processes, we found that trade-related activity would be recorded across the entire organisation, on an internal Blockchain, instead of records being "[…] *changed, go on to bits of paper, in a file, and basically those changes would not find their way into the way the calculation of the sheet was done"* (II). "The calculation of the sheet" refers to risk management, which furthermore describes the application area: "*You're effectively using the distributed ledger system as a method of processing millions of contracts, in a batch of one* […] *to update a position"* (II).

Primary issuance of assets was described as "*a factory approach, getting through hundreds and hundreds of raises, because it is scalable technology"* (VIII). In this application area, BCt, in combination with other technologies, was used to automate the entire issuance process of an asset for which, prior to the issuance, no tradable securities existed. The securities in this business case were called tokens; however, the meaning of this term varies, as will be explained in our evaluation. Effectively, in this business case, the equity of small and medium-sized enterprises (SMEs) was being issued onto a Blockchain. The settlement process, intrinsic to the primary issuance process, was almost completely automated.

Proceeding from the BCt-based primary issuance, we found the business case of a secondary trading platform: *"we are quite sure that what we are building – it scales from a legal perspective; it will be a multilateral trading facility and also can be scaled at the frequency that the current logic stock exchange"* (VIII). Similar to the primary issuance, given that the entire trading platform is based on BCt, "*on the settlement process of a stock exchange, all those back-office processes are really old fashioned and can be done very well much more efficiently with the Blockchain protocol"* (X).

4.1.3 Advantages

For the four application areas, we found several advantages of BCt in comparison to the currently used technology, as summarised in Table 4, page 57. **Higher transaction speed** was one advantage that we found in different ways across all business cases. For the application areas bilateral security settlement between organisations, primary issuance and secondary trading, higher transaction speed was primarily based on the reduction of intermediaries in the settlement process: *"You have depositories which hold the legal title, beneficial owners, people doing central securities depositories, you have brokers. The fact is we can remove this […]"* (VIII). For the application area of the

optimisation of internal settlement processes, **faster internal settlement** was explained to rely predominately on the use of smart-contract-based computations in comparison to given batch process calculations of derivatives. These included complex trading positions, reflected and coded in smart contracts, allowing for real-time queries: "*you're effectively using the distributed ledger system as a method of processing, in a batch of one rather the alternative solution, where you would have to process a batch of thousands"* (II).

The creation of **standardised, automated procedures** using BCt in combination with other software solutions was another advantage found in several application areas, especially in primary issuance: "*We've got a cookie cutter approach of getting legal frameworks in place and all of your different submission documents and everything else"* (V).

Furthermore, the fact that documentation on-ledger resulted in the establishment of an organisation-wide, **single immutable reference point** was considered an advantage over existing business procedures:

> *All sorts of things used to happen: Parts of contracts would be traded, contracts would be swapped, contracts would be lent and the audit trail around that would be lost. Or the audit trail around that would be in files of bits of paper.* (II)

In comparison to this, the advantage of the BCt-based system was the generation of trust amongst members of the organisation regarding the completeness of transaction documentation concerning a particular security. This was confirmed as part of a different application area, too: "*if you have a scenario or have multiple stakeholders and they won't trust each other. Blockchain's your technology of choice*" (VIII).

4.1.4 Assumptions

The first assumption that we found underlying all of the analysed Blockchain business cases was the possibility to **understand** the subject matter. This concerned not only the underlying technology but also business dynamics and procedures, especially in accordance with the given regulation: "*First of all, there was the question, 'what happens to digital rights if it's tokenised? Is it a security or not a security? And what is the legal status of a token?'"* (X).

Another key assumption was that **cost savings can be materialised** using BCt. In several business cases, this assumption was specific to a reduction of intermediaries in the settlement process, as we already mentioned in the previous advantages and will

evaluate as part of the business case goals: "[…] *it was the assumption, at first, that the technology has the potential to erase intermediaries and the assumption that you need to understand the technology and the business cases to evaluate these claims*" (III).

The **potential to scale** BCt was another existent assumption: "*A lot of our work has been on how to scale this in an efficient manner, using what we call Layer-2 technologies*" (VIII). Furthermore, the **existence of a market** for BCt-based solutions was voiced: The "*Assumption's that we do have a market*" (VI). As we will further specify in our evaluation, the market in question concerned a market for BCt-based securities and the service of a BCt-based settlement process, not a market for the technology itself: "*At the end of the day, it has to be profitable for it to work*" (IX).

Finally, we found an assumption that **approval** could be obtained for different aspects of the BCt-based solution: "*There's an assumption that the regulator would approve our process. It was very difficult to see this at early meetings we had with key people at the regulator, key people at law firms*" (VI). This regulatory approval was given for three of the application areas, whereas for the application area internal settlement, approval related to internal approval processes.

4.2 Process

In the following section, we present our findings on the process of the Blockchain business case.

4.2.1 Before Execution

Table 5 summarises our findings on the business case process before execution. Although one interview participant recalled following the subject matter since the inception of peer-to-peer distributed networks around 2010, all others explained that within their organisations, the topic **first featured** between 2015 and 2017. Regarding the **design** of the business case, the findings revealed that all business cases had been designed internally. Some cases were aimed at solving a business problem, with BCt considered as one possible technology to apply in the solution: "*The question was, 'What are the current problems in that area?' Then, […] 'can we use this technology to solve those problems?'*" (IX). Other business cases were designed to be explorative in nature: "*What companies are focusing on, is identifying the use cases*" (I); "*early we had, at least internally, some use cases that we had a deeper look on*" (IV). All business cases included an element of market monitoring as we will further explore as one of the business case goals.

Concept	Categories
Before execution	• **First featured** between 2015 and 2017 • **Design**: Internal and a "special case" • **Style**: No strictly defined, written business cases vs. clearly defined business cases • **Strategy**: Exploratory vs. results focused, with a recognised need for multi-disciplinary skills within team and work • **Funding**: Underlying financial calculations/rationale of the business cases • **Approval** process depended on internal and regulatory approval requirements • **Education, training, communication** - Internally: Project team and beyond - Externally: Regulators, partners and consortia

Table 5 Summarised findings: Process – before execution

In several cases, the **style** of the business case was described as intangible, non-formalistic and even "*non-existent on paper*" (IV), since either BCt projects were initiated out of an "*internal incubator*" (IV) or the budget for the work was financed out of a "*market observation, research and experimenting bucket*" (I). Furthermore, the majority of interview participants described the BCt business cases as "*special, and ring-fenced*" (V); "*it was definitely very bespoke and very one off*" (VIII). In comparison to other IT business cases it was described, that there was generally more freedom for the project team to learn about the technology, explore the market and experiment with the technology. However, given a result-orientated environment and generally less profitable business circumstances for financial institutions in Europe at the time, regular reporting requirements, even if less formal than for other business cases, were described. Furthermore, for this set-up to exist internally, strong support by C-level (such as CEOs and CFOs) or equivalent top management was described as indispensable for both the project's initiation and its continuation.

Findings concerning the **strategy** of the business case related to establishing a structure for implementing the business case and, more specifically, establishing a "research lab", an "expert group", an "incubator" or the like. The team was an important aspect, with the aim to have a balance of skills: "*You need that balance in your team; you can't have just entrepreneurial, and you can't have just corporate or can't just have technology"* (VI). The strategy of all business cases focused on using and fostering organisation internal know-how. Partnerships were also found to be part of the strategy of some business cases, predominantly with the aim to speed up the software development process.

Funding relied on quantitative financial calculations only for some of the business cases, as part of the process before execution. We found that in most cases, funding for research and development (R&D) was sourced from an organisation-wide pool, with DLT as one of several parallel technologies that were explored: "*it's a very young emerging technology, and we need to research it, which is quite complicated to argue within such a large corporation with all the cost pressure which we have"* (IV). In one case, a cost–benefit analysis was performed with estimates about potential cost savings versus development costs. Another business case relied on a profitable business model; that is, profitability was at the heart of the business case and, in fact, a prerequisite for obtaining regulatory approval.

Relating to the business case **approval**, we found that the time between the proposal and the deployment of resources differed for the various business cases and depended on the type of approval that was required. We found an obvious distinction between internal and external approval. In all cases, a large amount of education of stakeholders was required, as described in Section 4.4 on stakeholder. These included, for example, the executing team, internal staff, business line managers, external partners such as legal consultants and professionals at the external governing regulatory authorities.

Internal approval differed depending on the nature of the specific business case. For some cases, standard internal approval procedures applied, where the business case had to have either regulatory urgency or a defined payback period, normally in less than four years. Unless a business case fell within an "innovation bucket", it had to be approved as a "change project", win against other cases and pass audit and risk committees. We recognised that where "*DLT falls in the innovation bucket*" (I) or was classified as part of market observation and research activities, fewer internal procedures applied than for other projects, often without a written or quantitative financial business case in place: "*If you have or want to run a research lab, you will never have a positive business case with figures which give you a break-even in 3, 5, 7 or whatever years"* (IV). Strong and often personal involvement by top management to support both initiation and continuation of the project was identified: "[Names of executive managers] *are still co-lead of this lab, willing to give their employees the freedom to build up such a thing – this is very important*" (III).

External approval referred to regulatory approval, where we found that "*it was a special approval process*" (X); in all business cases "*– we had to submit* [a business case] *as part of the application process to become authorised*" (VI). The process required first

proving the technology in the regulator's "sand-box" – a testing space provided by the regulator – before obtaining a first licence and ultimately a "*licence for what's called multi-issuance, and that's when we really get going*" (VI).

Education, training and communication were found to be present before and during execution. Again, we organise our findings into two categories: internal and external. Internally, education, training and communication took place for two groups of people. The first group was the project execution team. The second group comprised people beyond the project team, such as C-level management and operative line managers, who were involved to tap into their business and product experience, which was required to develop the BCt-based solution. Externally, the process of educating the regulator and shaping the market together with professionals and officials at the regulatory authority was an essential part of the process:

> *This market evolved really through the regulation to say, we should be using tokenisation but linking that to an equity, and it being a true security and sitting within the securities regulations […] that whole process had to be ratified and explained and validated from a legal sense and from a regulatory sense.* (VI)

External interaction was found to provide education too. According to the interviewees, industry consortia such as R3 played an important role in the process of educating market participants on the technology, its use cases and its potential.

4.2.2 During Execution

We found that the **status quo** of the analysed business cases was at different stages of execution. For cases conducted out of a research lab or similar entity, separate projects existed to explore the technology – some projects were in the pre-execution (i.e. POC) stage, whilst some were being implemented, and others had already been executed and were in the evaluation stage. In other business cases, the implementation was divided into project phases, which also differed in their status quo.

Across all business cases, the **size of the team** was between five and 25 professionals, usually with core teams of five to 10 professionals for individual projects. These core teams were found to call on support from business professionals in the rest of the organisation who sometimes spent several days or even weeks with the core team providing business- and product-specific knowledge. Table 6 summarises our findings on the business case process during execution.

Concept	Categories
During execution	• **Status quo**: multiple ongoing projects or different phases for different parts of the business cases • **Size of team** between five and 25 professionals per project supported by business professionals or external contractors • **Prioritisation** increasing with execution progress • **Pivots** on how the business cases were implemented, not their content • No **external shocks** • **Practical set-up**: - isolated or ring-fenced project teams - a formal test case to test the technology • **Node management**: not distributed but hosted internally on virtual machines, with central access vs. no access • **Technological development strategy** • **Performance reporting** • **Team communication** • **Work in progress** • **Challenges** with regard to a. **Understanding the subject matter** of complex settlement processes; b. **securing and sustaining funding**; c. finding, recruiting and training **software developers**; d. **scaling and growing POCs** and the business as fast as possible; e. **establishing interfaces** between legacy internal and external systems; f. **abiding by legal regulation** and finding a **suitable jurisdiction**; g. **communicating and educating** internally and externally; h. **coordinating** various aspects of the business case.

Table 6 Summarised findings: Process – during execution

We found that the **prioritisation** of most business cases increased as the execution proceeded. This took place after the full potential of BCt had become apparent to senior management. After approval, there was a “fast” deployment of resources to fund all business cases.

In most instances, once the business case was formalised, there were no **pivots** on the content of the case. Only in one business case, during the execution phase, there was a pivot regarding what to use BCt for. However, pivots existed in terms of how the business cases would be executed. A progressively better understanding of the subject matter resulted in a development of the case, for example, because the initially vague project to find some use case for the BCt changed into an actual internal or client-related and goal-orientated project: “*the core business case didn’t change, but there have been a number of iterative changes”* (II). Moreover, changes occurred when the original business was supported with knowledge about the technology and surrounding

circumstances, such as the regulatory environment. For example, how the technical implementation would have to take place only became clear after understanding regulatory requirements. First, participants

> *[…] thought we could do all through Blockchain. […], but the problem is, we had to change that because from a legal sense, the legal provision within the companies law […] meant that we had to run through a nominee structure.* (VI)

A pivot was also found in the execution of another business case: a shift from building everything proprietarily internally to following a partnership strategy. No **external shocks** were found to have impacted any of the business cases considered.

We found that the **practical set-up** involved ring fencing the business case team, for example, in the form of an internal project team, incubator or "lab". Furthermore, it was found that the business cases initially required research and education, but they increasingly became more practical with few operating procedures and a strong reliance on trial and error to turn POCs into MVPs with the ability to carry out transactions: "*…at first it was POCs, so develop solutions that technically work. And then there was a shift in pilot transactions so that we do real business, but not scalable yet*…" (III). In cases where an existing system was to be replaced, the new BCt-based solution was run in parallel.

Concerning an approximation about the different practical tasks and their required resources, one interviewee explained that, "*As a rule of thumb, 15% of the effort goes into the technical stuff, 40% into the legal stuff and 30% into the operational stuff, and the rest is organisational: press release and so on"* (IV).

In one case, there was a formal test case, tokenising the equity of the holding company, first to test and refine the developed technology framework in a closed and safe environment and second to demonstrate the orderly functionality of the technology and procedures to the regulator. In fact, the test case was a mandatory step demanded by the regulator: Only if "*they're happy with it, we will obtain our full licences, and then we can offer this product out to the open market*" (VI).

We found differences in the strategy for **managing the Blockchain nodes**. There can be different types of nodes, but we apply the term for a so-called "*full Blockchain node*", which is a full replication of all the information stored in a specific Blockchain (Hess & Spielmann, 2017, pp. 158-159). We found that in some cases, the operating institution maintained effective control over the Blockchain without any decentralisation of nodes:

> *If the nodes lie physically at the customer, that is not so easy, because then you have to put up a network infrastructure between different companies, which due to IT security reasons and so and so on, is quite a large effort. So you rather do this on virtual machines, and that's what we do. We host them ourselves on virtual machines and provide access to the virtual machines to the clients, so they can actually run their own virtual machine but within a network that we configure before.* (III)

In contrast, in another business case, the interviewed organisation was "*the on-ramp to the technology. The technology itself is not a centralised database that can be corrupted by a centralised organisation or an external hack […] we can't touch the ledger*" (VI), and this characteristic of the BCt was considered to be an essential feature of the ultimate platform to be established "*to give also legal security, not only for companies but also for clients of the companies – generally, to anybody who holds a token*" (X).

The **technological development strategy** was found to be "agile" in all business cases, "*mostly canban*" (VIII), and differed in detail not only between the individual business cases but also in their distinct projects and phases. However, in all cases, developers worked closely with professionals from various business-related areas in relatively short and defined periods, or so-called "sprints", of a maximum of three months. Furthermore, in all business cases, the aim was to carry out technological development in-house to avoid purchasing technology from outside vendors.

Performance reporting differed between business cases: We found that it took place either only internally, only externally or in both directions. For some cases, reporting occurred as it did for all other projects, whereas for others, on a special project basis. In one business case, typical "normal" reporting was described, with greater managerial supervision as the business case moved from R&D into an operational phase. "*On a four-week rolling cycle, it goes to line management, and […] quarterly, it goes to senior management*" (II).

Another finding was that within all analysed business cases, **teams communicated** regularly and frequently. The aim was always to make decisions fast – in one case with a corresponding procedure described for reaching decision consensus: "[…] *when we're making decisions, if you have sufficient information, then it's green – you can then make a decision on it. If it's red, obviously no decision can be made. Amber – we have to assess – more work needed*" (VII).

At the time of our interviews, during 2019, the **work in progress** differed between the analysed business cases, but all cases included aspects of finalising tests, iterations of first trials and scaling BCt, for instance, by rolling out the technology across the organisations. In some cases, we found that work in progress went according to plan, with the technology having been in place and tested or applied to different use cases. For other cases, it was found that work in progress was behind schedule with regard to finalising tests, reporting to the regulator, obtaining full regulatory approval and "*automating and streamlining as many of the processes as possible*" (IX).

We found a number of **challenges** during the execution of the business cases:

a) From a technical, business as well as legal and regulatory perspective, **understanding the subject matter** or problem to be solved with the aim to translate the complex settlement process into a secure, fast and efficient digitally automated process was described as challenging. The complexity arose from often bespoke, complicated derivative products in connection with the complexities of the settlement process. Understanding the settlement process for subsequent translation into a BCt-based solution required extensive resources, including technical skills, time and expert knowledge as well as creativity to use the best possible combination of technology without succumbing to hypes.

b) All cases faced the challenge of **securing and sustaining funding**, primarily due to the difficulty and uncertainty for the project team to perform financial projections about a potential business case pay-off. Especially where the work involved a strong component of R&D, the business case was in competition with profitable projects. Funding was further challenging against a background of low profitability in the banking industry as a whole; unclear long-term prospects of the new BCt; and regulatory industry changes that frequently involved IT resources, competencies and budget.

c) The sourcing of human resources to support an aggressive growth strategy was found to be a challenge. Indeed, high demand for expensive IT skills was identified across all cases. Several interviewees emphasised a common industry challenge of **finding, recruiting and training highly sought-after software developers**, preferably with experience in the coding of BCt: "*For this type of skills, you are competing with the Facebook, the Google, the Apple, so companies that are perceived in this space, a lot cooler than the banks"* (I).

d) **Scaling and growing POCs and the business** into an operational mode was considered an important and challenging step. Scaling as fast as possible was seen as essential to gain market share in an increasingly competitive market with a perceived growing competition from both established and several FinTech companies in the settlement area.

e) Another challenge was explained to exist, concerning **interfaces**, both with legacy systems and with external systems. Concerning internal interfaces, the question was frequently, whether to integrate the BCt based solution or whether to replace the existing system. Concerning external systems, the challenge was the lack of and resulting uncertainty about common standards.

f) **Abiding by legal regulation** was another challenge because in many European countries, financial regulatory bodies are only in the process of providing legal certainty; hence, to "*…actually issue a dematerialised security on-ledger, so you have to develop like legal frameworks for that"* (I), potentially requiring the legal settlement of transactions in foreign jurisdictions, where the legal environment provides a more convenient framework. Therefore, **finding a suitable jurisdiction** and regulatory environment that accommodates a purely digital, dematerialised security on-ledger was a challenge.

g) Continuous **communication and education**, not only internally between team members but also externally and especially with the regulator on this completely new area, was considered a challenge: educating staff at the regulator and ensuring that the technological processes work not only technically but also legally. In this regard, another challenge in some cases was the education of internal staff members as to how to behave in a strictly regulated business environment: "*everyone needed to be trained up to a certain standard. That was a big challenge. Working in a regulated environment is very different to working in sort of a normal business environment"* (VII).

h) Another challenge related to **coordinating** various aspects of the business case. The speed of multiple processes, across all involved parties, internally and externally, from a technological and legal perspective, had to be synchronised.

4.2.3 After Execution

Pertaining to the business case process after execution, our findings, as summarised in Table 7, relate to aspects of the business case evaluation. We found that the evaluation was either predominantly carried out by the executing business case team or conducted

by an external regulatory body. For all business cases, the evaluation had a strong focus on results.

Concept	Categories
After execution	• **Nature of evaluation** - internally required and driven - regulatory requirement • **Evaluation criteria** - cost of the project vs. achieved or potential savings - progress vs. plan: deviations off plan, behind schedule, reasons • **Content of evaluation**: technology application, legal aspects, business integration, functionality and security • **Overall evaluation:** high internal importance - amongst other business cases - considered as anchor/reference project

Table 7 Summarised findings: Process – after execution

The **nature of the evaluation** differed between the business cases. Where cases took place internally and were in an early, experimentation phase, the evaluation was more informal than in business cases where closer regulatory oversight and approval processes were given. In the former cases, standard evaluation procedures, such as a traffic light reporting and evaluation system, were recognised: "*We meet every Monday with strict kind of milestones, strict deadlines, that we try to achieve in terms of evaluating the quality of the work; we make decisions fast, based on all the information we can have to hand*" (VII). In some cases, evaluation took place in the form of feedback from market participants.

The **evaluation criteria** were generally based on the cost of the project, measured against the potential or achieved savings and/or the progress of the business case, measured against the original plan. For some business cases, the progress was on plan without deviations, whereas in other cases, ambitious timelines had to be adjusted. For one of the business cases, the explanation for the deviations from the plan were external regulatory reasons, which required amendments of certain aspects.

The **content of the evaluation** primarily concerned the technology application, the way in which legal aspects were dealt with and the way in which business integration worked: "*we've got a tech evaluation; we've got functional evaluation; we've got security evaluation – evaluation for the FCA*" (VI). Questions that the project team posed to evaluate their business case included the following examples: "What exactly was put on-

ledger, and what is still administered on some legacy system? What advantages or improvements were gained for the business using the technology? How did the processes and products change given the use of the technology?"

As an **overall evaluation**, we found that the business cases were all considered to be of high internal importance. All of them had to adhere to some form of evaluation criteria, either organisation-internal or imposed by external regulatory processes.

4.3 Goals

In this section, we present our findings subsumed under the dimension goals. In our coding process, as described in Section 3.4 (page 41) 20 categories emerged that we subsumed to 10 concepts, as summarised in Table 8 and presented below.

Concept	Categories
Cost reduction	1. Reducing cost of security settlement 2. Reducing cost of capital raising 3. Reducing cost by decreasing the number of intermediaries 4. Increasing operational efficiency
Internal competences	5. Developing internal competencies
Market monitoring	6. Observation and monitoring the market
Risk management and reduction	7. Optimising risk management 8. Creating an immutable audit trail 9. Reducing operational risk 10. Reducing counterparty risk
Political and regulatory reasons	11. Setting standards 12. Adhering to regulatory requirements 13. Increasing transaction certainty
Increasing transparency	14. Increasing transparency
Market efficiency and liquidity	15. Promoting market efficiency and liquidity
Business opportunity	16. New revenue opportunities 17. Increasing client services
Settlement speed	18. Increasing settlement speed
Competitiveness	19. Public relations 20. Maintaining competitiveness

Table 8 Summarised findings: Goals

1. Cost reduction was found to be a goal in all of the analysed business cases. Potential cost reductions were predominantly based on **cost reductions of the security settlement** process: "[…] *11 billion dollars is wasted among just, mostly banks, on the settlement annually*" (I); *"My theory on it all is that maybe these systems cut costs by a third*" (II). Some interviewees attributed this goal to the decline in profitability of the finance industry, which resulted in a heightened need to optimise all non-value-adding activities, including security settlement.

2. Cost reduction was also found to be possible as part of the settlement process through a **reduction in the cost of capital raising**, for example with an alternative to a traditional equity IPO: "*Why would* [a company] *spend 10% or 15% with a Morgan Stanley, J.P. Morgan, when they can spend 1%, 2% with a streamlined tokenisation platform that does the same thing?"* (VI). In this respect, we found that lower costs were often linked to more streamlined processes, especially a reduction in transaction and legal advisory fees through the utilisation of standardised contracts and templates integrated into a smart-contract BCt-based digital process. These contracts and templates were explained to replace expensive bespoke legal services that commonly create high costs in an issuance process.

3. A lower cost of the settlement process was associated with a **decrease in the number of intermediaries** involved in the settlement process, in comparison to the given market structure, rendering this a business case goal:

> *You have all these expensive ways of things being settled across and you essentially have all these people doing bookkeeping. […] we can remove this to one single settlement layer* […]. *And, at least for me, that's where the biggest value proposition lies. (VIII)*

4. We found the business case goal of **increasing operational efficiency**. In some cases, inefficiencies in the form of many people manually having to deal with settlement-related work, such as reconciling and reporting processes, initiated the search for a technological improvement. The aim was to translate the efficiency gains of a cheaper, faster solution into cost savings. In another case, the goal was to combine BCt with other technologies to automate processes, allowing for a full issuance to occur almost instantaneously and in full compliance with regulation, and ultimately increase operational efficiency.

5. In all of the business cases under consideration, we identified the goal to develop BCt specific **internal competences** amongst the organisations' staff. In one case specifically, the motivation was to establish a business case to carry out research "cases" in order to test and discover the technology: "*We want to learn this stuff rather than buy it from a third-party vendor or buy it from the start-up"* (II). We recognised this goal in the other business cases too, albeit less precisely, in the form of the motivation to train and work with own human resources instead of hiring outside consultants.

6. **Observation and monitoring of the market** was found to exist in different ways in all business cases: "*[…] no one wants to be behind the competition. So they are monitoring"* (I). In an explicit and active form, in one case, the idea was to build an internal knowledge team of experts and software engineers to understand and leverage the technology with few external consultants, test use cases and monitor the market. In the other business cases, market monitoring was a less explicit but still existent goal.

7. For one business case in particular, we recognised the goal to **optimise risk management**. This was pursued via the establishment of a new system of real-time risk management, rather than the use of Excel spreadsheets where calculations could take two days, twice a month: "*That's the goal – to get rid of the spreadsheets!"* (II). By introducing a BCt-based solution to efficiently connect different parts of the organisation and aggregate risk across the entire organisation, the aim was to visualise, control and potentially reduce risk.

8. **Creating an immutable audit trail** was a goal related to an improvement of risk management, such that several internal parties (e.g. management, trading, risk and compliance) could access trading data with various levels of rights, and every access, addition and change could be stored on-ledger, thus creating an immutable audit trail: *"The other big thing is they then get an audit trail. So if part of the contract is traded, they will see. The accountants will see part of the contract is being traded, and they couldn't see this before"* (II).

9. In relation to the previous two points, we found that a **reduction of operational risk** was a goal behind establishing a BCt-based risk-reporting system. Over time, with growth in both the business size and the complexity of derivative products, the cost of risk management increased over-proportionally, driving the search for technological improvement of a combination of error-prone spreadsheets to calculate risk positions. These sheets, which could take several days to calculate a current risk position of a single derivative, were prone to human errors and were inadequate for the purpose, posing an operational risk: "*For them, it's solving a complete nightmare. Because, holding data in spreadsheets when nobody understands the calculations. And then at the end of the month, you send a bill for millions of dollars to the client […]"* (II).

10. Furthermore, on the topic of risk, we found that a **reduction of counterparty risk** was a goal in several business cases. A risk reduction effectively took place if counterparty risks were visualised almost in real time with a better risk management, as

explained in the previous goal, such that counterparty margins could be called more frequently and in smaller increments. Moreover, in other business cases, we recognised how BCt eliminated counterparty risk altogether, given immediate settlement. In one of the bilateral trades of one of the business cases, there was zero counterparty risk because the system did not track intraday settlement.

11. We found that being part of the process to **set standards**, or at least influencing regulatory developments, was another business case goal: "*another important topic for us is setting standards, or at least being involved in setting standards. So we are very actively working with lobbyists with politicians and so forth and with regulators*" (IV). Given that a need to be involved in this technology had been identified on an executive and shareholder level, the business case included an element of participation in the setting of regulatory standards. In one business case, the company worked closely with industry representatives and politicians to shape the future regulatory landscape.

12. Although the degree of involvement of the regulator differed between the business cases, **adhering to regulatory requirements** was a necessary business case goal in all of the analysed business cases. Even in the business case where BCt was used to optimise internal settlement procedures, the regulator was involved because the financial institution was regulated as a whole and especially, its risk monitoring systems.

13. From a different angle, the goal was to optimise the reporting process, and thereby to **increase transaction certainty**. The goal was for the regulator to have a node such that a shift could occur from "*an institutional regulation to a transactional regulation, where each transaction is regulated"* (III). In pursuing such a goal, transaction certainty would be increased.

14. **Increasing transparency** in the settlement process in different ways was found to be another goal, present in more than one of the business cases. In one case, as explained above, this goal was found in relation to risk monitoring in the form of a new visualisation of risk in a network rather than in a "debit-credit" format – applying a network topology to risk management and allowing for various parties, such as management, trading, risk and compliance, to access the data with various levels of access, and simultaneously creating an (immutable) audit trail. In another case, it was found that a lack of transparency in the capital market for small to medium-sized companies' equity resulted in the goal to increase transparency by advancing a technology that allows for a streamlined and transparent means of financing: "*[…] billions of money* [are] *floating*

around between angel investors, high net worth individuals, private equity and VC funds, all that sort of area – very intransparent, very illiquid" (VI).

15. Related to the goal of transparency, we found the goal of **promoting market efficiency and liquidity**. For one business case, this aim concerned the increase of capital market efficiency of the transaction for both sides – those seeking investments and those wanting to invest: "*at the really early stage start-up, there's no liquidity for an investor. They're not going to be able to trade, do anything with their shares for a long period of time*" (IX). For those seeking financing, the goal was to provide a better, more secure and more persistent source of funding in comparison to current possibilities, where, especially in the start-up and growth phases, we were told that raising capital is often impossible, expensive and cumbersome. Moreover, even if an initial capital raising was successful, follow-up financing was described as being uncertain, with the risk of an otherwise good business failing:

> *Say you're raising money for a small company; you go to Kickstarter, maybe get some friends and family to invest, an angel investor. Then you're like, "OK, we've raised enough"; you go to the private equity or you know someone comes along. Then you eventually IPO, list, maybe get some debt funding and then, yeah, do an LBO [leveraged buyout]. Now, going for this small market, what happens when the IPOs happened at the start? Technically, if we've made liquid assets that can be traded, do people then need to go through all these different stages?* (IX)

16. The prospect of discovering **new revenue opportunities** was found to be another goal closely related to the opportunity to supply an existing market demand in another case. More than one interviewee explained that if it were possible to find a good solution, there was potential to capture competitors' market share, for example through better client services such as more transparent and faster settlement services.

17. A goal stated directly in one of the business cases was the potential to **increase client services**: "*it's also customer satisfaction. So if you have a transparent, fast process, this is in favour of our customers*" (IV). Additionally, client service was recognised as a motivation in another business case, linking this point to Point 18:

> *Clients want to get money through as quickly as possible – you know how long it takes to raise money in the old way, going through something to go public, going through your lawyer or go to a bank and friends and family round and do your round A or B, C or private equity is kind of established kind of roots, whereas this market is a completely different, much faster business proposition.* (VII)

18. **Increasing settlement speed**, as introduced by the above quotation, was a goal that we discovered in all business cases, albeit in different ways. First, we observed that the reduction of intermediaries and required process steps carried out by these intermediaries translated into faster settlement. Second, for another business case, BCt was found to speed up the settlement process involved as part of the primary issuance process. Third, the use of BCt-based systems to change regulatory approval, moving from an institutional to a transactional regulation, as explained in Point 13 before, can increase settlement speed.

19. We found that **public relations** and announcements of activity and progress in the area of Blockchain was a goal in some of the business cases. This did not apply to all business cases, with the marketing aspect even being neglected in some cases: "*What is quite sad, we don't do very good marketing*" (III). Regardless of whether the element of market relations was present, we found that financial institutions faced public pressure: *"[…] management then get asked questions by analysts – 'JP Morgan's got a coin. Why don't you have a coin?'"* (II), revealing that if not directly, public relations constituted an indirect goal.

20. The goal of **maintaining competitiveness** prevailed in all business cases, with an identified need to monitor the market, as explained in Point 6 before, to ensure that the own organisation was not lagging behind the competition, that nothing essential was missed in the market and that one's own activity was marketed as effectively as possible. We found that increasing competitiveness and the entrance of younger and smaller firms with lower cost bases trying to introduce low-cost, BCt-based settlement solutions were seen as a threat to existing business models. We noticed the realisation that technological change will occur, and the question was whether to participate in the trend: "*the business will change, and then we'll rather be the first to do it*" (III).

4.4 Stakeholders

We abstracted our codes relating to people or groups of people involved in the business case under the concepts presented in the following section as summarised in Table 9.

Concept	Categories
Internal stakeholders	• Internal team - Diverse skill sets and backgrounds - Five to 10 professionals per project - Support from outside the team, within the organisation - Geographically concentrated in one location • Senior-level management

External stakeholders	• Few external advisers: Legal and IT contractors • Software development partners • Specialised IT service providers • Financial services regulator

Table 9 Summarised findings: Stakeholders

Linked to the size of the team we considered a part of the business case process, during execution earlier (page 64), for all business cases, we found that a dedicated "core" **internal team** had been established, for example a project group or expert group, an internal start-up, an incubator or a research lab. In all cases, this core team was sized between five and 10 people and was found to include *"really special people to this working group"* (X).

In all cases, these professionals were found to be from different backgrounds, comprising **diverse skills**, such as corporate strategy, business analytics, accounting, back-office clearing, legal, trading and information technology including software development: "*[…] visionaries of the token economy. Other technology engineers, IT experts; others were professors for financial market regulation; others were practitioners, lawyers, actively working with Blockchain and so on*" (X). The teams of the interviewed organisations were primarily **geographically concentrated** in London, Frankfurt and in one case also New York, with a few team members working from a different location than the rest of the team.

This core team, in all cases, was found to operate in close contact with a larger group of **supporting professionals** – either experts within the organisation or external experts – such that the entire team size depended on the business case and its phase: "*some* [people from the business] *will work a month or three months actually for the case with at least 40% capacity*" (II). The people at the core of the business case possessed several years of experience, had usually been part of the organisation for a long time and were highly accustomed to its culture.

The involvement of **senior-level management** was recognised as an important factor in all of the business cases: "*Unless it comes from the senior people at the top, it is very difficult to identify budget to create these teams"* (I).

Few external advisers, if any, were found to be involved in the business cases. The only external stakeholders we encountered, involved in almost all of the business cases were legal advisors. External development contractors were found in one business case

to supplement the internal team. A **software development partnership** was established in one of the business cases, with the aim to accelerate the development process. In another case, the initial involvement of **specialised IT service providers** (e.g. IBM with its Hyperledger Fabric and Oracle without its own "Blockchain" fabric) was explained: "*Oracle does not have its own Blockchain fabric with the strategy, that anything can be linked to their cloud"* (II). We found that the governing **financial services regulator** was a stakeholder in all business cases.

4.5 Risks

We subsumed the various risks that we found under the dimension "risks", as listed in Table 10 and described in this section.

Concept	Categories
Project risk	• Project risk - Investment without results • Limited resources
New technology risk	• Vested interests • New untested and potentially less reliable technology • Provision of continued support
Interoperability risk	• Lack of interoperability between BCt - No common standards • Legacy systems
Responsibility risk	• Responsibility for assets • Criminal activity • Custody / private key management • Single point of failure (SPF)
Regulatory risk	• Regulatory and legal risk and uncertainty • Political factors
Strategic risk	• Reputational risk • Competitor risk • Path dependency / first-mover risk • Public relations

Table 10 Summarised findings: Risk factors

We found various risks relating to the business case planning and execution. Such uncertainties may be described as **project risks**, including a failure to attract sufficient market interest and bring the solution, developed in the business case, to market. Furthermore, potential business case risks were seen in the inability to realise the goals of the business case, for example to reduce operational costs as planned; in the worst case, this would result in an **investment without results** that were advantageous or meaningful: *"At the moment, the main risk is failing across all different dimensions – not getting any output, not getting any traction from the market, not really being able to create scale and reduce costs"* (I). Connected to this, we found the risk of **limited resources**

to address the technological development successfully. If the organisation aiming to implement the business case realises "*that they don't have the money and the problem is bigger than they are, and they can't find a solution on their own"* (I), that is a risk.

Another risk was described in the fact that BCt is a **new, untested and potentially less reliable technology**, which runs the risk of being less stable and experiencing more frequent crashes and outages than existing systems. Interviewees connected this point with the risk that **vested interests** could supersede the benefits of BCt, for example for incumbent financial institutions that "*want to keep existing systems going and not change because that maintains their profits. The ability to extract rent from financial transactions […]*" (II). Also related to new technology risk, were concerns about the **provision of continued support** for BCt, referring to a potential lack of professionals with corresponding knowledge.

We identified **interoperability** and **common standards**, or rather a lack thereof, as risks to Blockchain business cases, given that "*competing Blockchain technologies"* (VI) exist without a unified standard across the industry. The concern and risk seen for some of the business cases was that a lack of interoperability and standards across the industry would result in the BCt working in inefficient "silos": "*we're trying to build standards into those platforms for interoperability in the future. If we don't do that, we'll have silo-based technologies, and it'll become very difficult"* (VI).

Furthermore, we identified the risk pertaining to **legacy systems**. For one, and linked to the previous point, there is the risk that existing systems cannot interoperate with BCt and that a migration from them is costly: "*you're into billions and billions of dollars to replace them and the backup and to transfer them from the old systems to the new system"* (II). Moreover, the risk was voiced that BCt is not used as efficiently as possible, because legacy systems continue to be used for certain processes, with the result that "*[…] you don't have the whole security lifecycle 'on-chain', and thereby you have to swap from the legacy system to the DLT systems, and that makes the process more complex*" (III).

Responsibility risk emerged as another risk concept. In the business case involving a platform to raise capital, effectively intermediating between assets and investors on a technological basis, employing BCt theoretically eliminated the need for an intermediary. However, responsibility exists in the process of accepting assets onto the platform in the first place. The responsibility risk is therefore associated with the right level of asset pre-

screening. It was explained that on the one hand, it is in the interest of both investors and the platform operator to ensure a high standard of assets, thereby potentially assisting investors in better subsequent investment returns. On the other hand, this due diligence is costly and time consuming and potentially results in a lack of due diligence on behalf of investors, who could tend to forgo detailed due diligence on the assumption that all assets that have been accepted by the platform "[…] *must be good to invest in*" (VI). We found that there is a standoff between having to maintain efficient, fast and streamlined processes on the one hand and ensuring that assets with, for example, a criminal motivation are excluded from being funded on the other.

Criminal activity was considered a potential risk factor in another business case: "*We've gone through and stepped through the major risks: Security risks, I'd say fraud risks, money laundering, criminal activity, terrorism financing – risks"* (VI), essentially putting the business case at risk if the assets for which funds are to be raised via a platform are not what they are claimed to be.

We identified **custody** as another risk factor. It refers to the risk surrounding **private key management** and the existence of a **single point of failure (SPF)**. In an extreme form, if only one individual carries the key, the risk of loss of valuable data as well as misuse is given:

> *Who's going to hold the private key? You as a trader? Then there is this point of failure; if you don't come to your office tomorrow, then we lost access to 50 million bucks just because you hold the private key.* […] *you have to have few eyes confirming the transaction. Now, in that perspective, how do you marry this with the efficiency in the day-to-day operations? That's where the puzzle is.* (V)

Another interviewee highlighted these risks. He reasoned that although in contradiction to human factor science research, which had induced a reduction of human errors in other industries, multi-signature procedures were at odds with the trading floor and investment banking culture:

> *Go up to Cranfield University, one of the leaders in Human Factor Science for aerospace, and you will see how this system can be deployed to ensure that the humans in the system react to the data in the system in a way that they continuously reduce risk. But the financial markets and the culture of trading and the culture of investment banking are not there at the moment on that.* (II)

Regulatory risk emerged as a concept based on our findings that regulatory risk was caused mainly by a lack of regulation and the resulting **regulatory and legal, risk and uncertainty.** This related to how the regulation could change and affect the business

case, given that the legal framework largely defines technological requirements in the securities space: "*there is a lot of uncertainty and risk around the requirements that you are building"* (VIII). Likewise, we found a lack of trust amongst market participants, such as investors, who refrained from investing in on-chain assets given the relatively immature technology, incomplete legal regulation and short track record.

We found **political factors** as a risk in relation to the cross-border development of BCt, with the settlement of securities in particular currencies most likely to be restricted to the respective geographical boundaries and some select foreign hubs:

> *The United States will do everything to ensure that you can only settle dollars in the United States, and Europe will do the same with the Euro. China has allowed one place outside of China, which is London, to trade and settle Renminbi, Yuan outside of China, but the People's Bank of China is right next door to the Bank of England.* (II)

The concept of **strategic risk** was found on the basis of categories concerning market reputation, competition and strategic corporate developments. A **reputational risk** was recognised because of a lack of understanding and a misunderstanding of the subject matter of BCt – some people, within and beyond the interviewees' organisations were explained to associate Blockchain with Bitcoin, and Bitcoin with criminal activity. In almost all business cases **competitor risk** was found to prevail: Someone could find a better, more efficient way to solve the problem. However, equally, we found a **path dependency risk** of being a **first mover**, namely developing and implementing things that turn out to be incongruent with external developments, either regulatory, for example on an international level; technologically, with other technologies having advanced; or economically, with the market having moved in a different direction.

4.6 Environment

Concerning codes and categories that emerged with respect to the business case environment, we developed the dimension "environment", as described below. Table 11 summarises our findings and lists the three concepts that emerged in our theoretical coding process.

Concept	Categories
External environment	• Market and cultural environment • Consortia • Common standards • Regulatory environment • Impact of external events
Internal environment	• Internal corporate environment
Past and outlook	• Impact and change of the environment in the past years • Expected impact and change of the environment going forward

Table 11 Summarised findings: Environment

In regard to the **market and cultural environment**, we recognised banks' understanding that competition should take place in higher-margin businesses and that collaboration makes sense in low-margin operations. **Consortia** such as R3 and SETL were consequently set up. However, membership was explained to be passive and with a high churn rate: "[…] *if you look at the membership of all of those people join, they either drop out or are very passive"* (II). We further found a resistance to collaborate and pursue open-source or shared concepts: "[…] *the question is, do we need R3 for all cases, and the answer is NO."* (III).

We also found that for one business case, this culture was initially present but changed with the realisation, during its execution, that given the market environment, the business case could not be handled alone: "*It would have taken a long time and cost many more millions to do. We didn't have the investment to do that or the time to do that. There is a lot of competition in the market"* (VI). We learned that it took banks a long time to become more relaxed about APIs. Furthermore, we found that in modern agile software development, the common business culture of constantly testing and proving internal assumptions in discussions with others was critical.

We found that **common standards** implemented across trading and business partners were an important issue for BCt business cases, as reflected by the concern of a senior architect in charge of the software development of one of the business cases: "*my major worry […] was to build a small closed ecosystems; this is not what we want to build. If you want to eventually scale* […]*, you need common interoperability standards, where everyone's talking the same language*" (VIII). In fact, the success of one particular business case was largely found to depend on interoperability and communication between different chain technologies: "[…] *for us to succeed, for us to achieve our goal, make issuance less expensive, making issuance faster, we need these standards in place.*" (VIII).

The **regulatory environment** was identified as a critical aspect, ultimately determining the legal environment and hence, in different ways, the business case directly. In one case, a formal business case was written to obtain regulatory approval. For the considered business cases, we found that regulators were well aware of what was happening; they worked on regulatory updates and tested with market participants in so-called "sand boxes", which are essentially digital testing environments, as they recognised the potential of BCt: "[…] *they are very aware of the Blockchain capacities – I'll call them 'chain type systems', 'chain type databases', to significantly offer settlement efficiencies*" (II).

As for the Financial Conduct Authority (FCA), the UK regulator applicable to some of the business cases, we noted that interviewees found it productive to work with the authority: "*The FCA has been a very pleasant surprise for me. I think they are very well educated, more than I expected and more willing to listen than I expected them to do*" (VIII). Several business cases had to be adjusted to conform to regulatory requirements, for example the introduction of a nominee layer: "*So there's effectively a nominee in the middle, which effectively has responsibility for validating who has what"* (VI). In another case, the legal jurisdiction was located outside of the home jurisdiction to implement the business case: "*it's not German because it doesn't work, as the WpHG [Wertpapierhandelsgesetz] still needs paper, the physical paper, but Luxembourg is a competitive space for securities."* (III).

It was recognised that the regulatory environment was a key to providing legal certainty for the business cases, not only nationally but also on a cross-border scale; for example,"[…] *if you, as a Lichtenstein company, have a German client, it is necessary to have the legal certainty there too"* (X). In this respect, the finding was that the regulator's definition of the financial market mattered: "*we had to determine what are financial services or what is the financial market in total. And because in times before there was Blockchain, it has been very clear* […]" (X).

Inquiring about the **impact of external events**, we found that none of the business cases were significantly impacted. In fact, in one case, external events affirmed the given strategy: "*Some problems that appeared in the world of Blockchain, like a hacking of crypto exchanges or so, just supported the decision* […]" (X).

The **internal corporate environment** also mattered for all business cases, from their approval to their execution, and the potential "*is seen very clearly by executive level and by the level of the heads of these different areas, underneath the executive level – they are supporting it heavily and pushing it also into the market*" (III). To create a productive environment, we found that for all business cases, internal innovation hubs, research labs, expert groups and the like had been established. In another case, the corporate structure was based on the categories of change versus innovation; BCt business cases were structured based on the innovation team, where modern development structures allowed for technological exploration: *"[…] nowadays, you have IT people, called agile developers, who understand about the business as well, and you have a lot of business people really passionate about the digital."* (I).

Finally, our findings revealed that BCt was found to have had little **past impact and change on the environment** of given BCt business cases in the trading and settlement space. At the time of the interviews, the statement that "*there is no productive solution running in financial markets*" (III) was made, and that therefore no impact had occurred. However, another finding was that an impact had taken place because institutions, both from the private and public sectors, had begun to engage, experiment and understand the technology.

In addition, research and experimentation had become increasingly formal, and awareness amongst market participants had heightened: *"I think a lot of people in the financial markets have seen what's coming from this intermediation perspective.* […] *all the bookkeepers, they know they'll be out of their job, and they're already investing in the next solution"* (VIII). It was explained that market participants, especially in the settlement layer, were starting to react and prepare for a structural change, as seen, for example, in the investment of LiquidShares by EuroClear.

Moreover, expectations were found to have changed "*from 'this is a revolutionary technology, which is going to change the world' to where it is now: 'this is a different form of database, which has effective security within it, which is useful'".* It was found that unregulated activity had almost completely moved into the regulated space: "*And nearly all of the unregulated side has kind of drifted away. It's now moved pretty much into all of the regulated side...*" (VI). With more jurisdiction formalising the regulation around BCt, and legal certainty thus increasing for Blockchain business cases and their content, we saw that *"*[…] *this is just happening now and with a huge momentum* […]" (X).

In seeking to learn about an **expected impact and change in the environment going forward**, we found an unanimous consensus that the technology will be "*Streamlining* [the financial market]*, making it much cheaper, faster, better for companies, for institutions for individuals – a dramatic change.*" (VI).

Such a change, most likely on a per-product basis, would require a technology adoption with a climax: "*at one point, you can really get adoption quite fast, but it needs a lot of time until this point is reached. So I think there will be one point where there really is a shift and where you really gain traction"* (IV). Furthermore, according to our findings, such a point could occur, depending on whether the existing infrastructure, processes and products are ready. With many people active in the market now:

> *There will be a time where all the efforts match together and you get the strings together, and if you have digital cash and mutual security, the technical DvP is simply a by-product of that. And this may release this tipping point.* (III)

For most of the business cases, with operating POCs in place, the goal and challenge alike was a matter of scaling the technology for it to have an impact. Another aspect of adoption and market impact was observed in the activity of smaller actors: *"smaller firms will lead the charge rather than it being from larger institutions,* […] *where you have a big legacy and change there costs a whole lot more"* (VII). Investors were also found to drive change with their increasing understanding of the benefits of the tradability and liquidity allowed by BCt. However, it will take time for investors to hear, try and understand the benefits from the processes induced by BCt.

Another impact on the future market environment concerned the share certificate and a possibility of its disappearance:

> *The idea of a share certificate will disappear, and we'll get rid of the idea of legal ownership and beneficial interest, and you'll just have this sort of concept of a legal beneficial ownership, where you have something that is yours and that when I move it, it will just move, and that's legally viable.* (VII)

An interviewee explained this concept of a legal beneficial ownership that will be easily movable as being market led and pursued by companies, for example in Delaware. Moreover, it was found that for certain high-liquidity markets, such as for common equity shares of blue chip corporations, trading on the major stock exchanges, the share concept would likely remain, with a parallel world emerging for

> […] *the things that are not possible to be listed on an exchange,* […] *this is the new world that will happen and will have a major impact on our economy and also on the financial markets because it opens up the scope of financial market*

to almost everything. This is interesting – it will have a big impact on the prosperity of our economies. (X)

4.7 Key Findings

In this chapter of our dissertation, we presented our findings in six sections, in line with the highest level of abstraction from our coding process, namely our six dimensions. The concepts that emerged from our coding process for the first dimension, namely the **application area**, were the use of BCt in the space of security settlement and the corresponding descriptions, advantages and underlying assumptions. We found that beyond the settlement of securities between organisations in a Blockchain network, BCt business cases also featured the administration of internal settlement processes, the primary issuance of assets and the establishment of a secondary trading platform. Next to the advantage of BCt that it is able to increase efficiency and hence reduce costs, other advantages, such as greater liquidity and transparency, were also found. The assumptions underlying the business cases were that the complex subject matter could be understood, BCt could reduce cost and that the technology could obtain regulatory approval and be permitted to operate in the given jurisdiction.

The second dimension was the **process** of executing the business case, and the concepts followed a chronological structure: before, during and after execution. We found that financial calculations and questions of funding took place not only before but also during execution. The execution was generally pragmatic, and in several business cases, it was both strongly influenced by regulatory reporting requirements and results-driven. During execution, numerous challenges were encountered, including the comprehension of the complex subject matter, the establishment of interfaces with other systems, and communication and education internally and especially externally with the governing regulatory body. Depending on the specific use of the BCt, the evaluation process after execution was more or less dependent on the regulatory government of the business case.

Goals emerged as the third dimension. All business cases shared the goal of implementing BCt to reduce costs. However, we found several other goals. Our selective coding process resulted in the conceptualisation of 20 categories and the following 10 concepts thereof: cost reduction, internal competences, market monitoring, risk management and reduction, political and regulatory reasons, increasing transparency, market efficiency and liquidity, business opportunities, settlement speed and competitiveness.

Stakeholders constituted the fourth dimension to emerge from our coding process. The corresponding concepts were internal stakeholders and external stakeholders, with C-level management and the regulatory body being important internal and external stakeholders, respectively, in varying degrees, in all of the business cases.

The fifth dimension consisted of **risks** that were explained during the interviews. These risks resulted in our abstraction of the following six concepts: project risk – the business case failing; new technology risk given a potentially lower reliability because of a lack of experience and support; interoperability risk, both between BCt and legacy systems as well as between different Blockchains; responsibility risk, for example for the settled assets, a criminal misuse of the BCt custody and a single point of failure and strategic risk concerning public relations and reputation, competitive threats and path dependency.

The sixth and final dimension that we established was the business case **environment.** In this case, we abstracted the concepts external environment and internal environment as well as a third concept referring to the past and potential impact of BCt on the business environment in the financial security settlement space. In almost all business cases, internally, the corporate environment, defined by senior-level commitment to BCt and new technological innovation in general, were important. Externally, the regulatory body and the readiness of legislation were found to have impacted the BCt business cases most significantly.

We discovered that BCt has already impacted the business environment, if not in the form of implemented solutions, then at least in the form of market participants' awareness of substantial potential changes. Indeed, the unanimous consensus was that BCt will continue to substantially affect the business environment surrounding security settlement going forward.

5 Existing Models and Frameworks

The purpose of our research, as reflected in our research goals and research questions stated in Section 1.3, page 7, was to explore why BCt is being implemented in the security settlement of financial institutions. To this end, we examined the key aspects that were considered in the institutions' business cases. As part of our literature review, we also considered models and frameworks concerning technology business cases. After explaining our GTM in Chapter 3, we presented our findings in Chapter 4. We now turn to the first part of our analysis. The purpose of this part is to address and answer our first research question:

> *Research Question 1*
> *What existing models and frameworks are available to evaluate technology business cases, and how suitable are they to evaluate Blockchain technology business cases?*

In our literature review in Chapter 2, we considered a number of technology models and frameworks because of their relevance for the analysis of business cases or their analysis of BCt. We summarise and reconsider these in Table 12.

Model/ Framework	**Author(s) (Year)**	**Short Description**	**Considered relevance for BCt Business Case Analysis**
Business case framework for group support technology	Post (1992)	A framework for analysing aspects to make successful technology investments.	Relevant given the finding that a business case approach is devised to evaluate a technology implementation in a complex and dynamic business environment.
Framework for developing a business case and Benefits dependency network	Ward et al. (2008)	A matrix to assign IT investment benefits to levels of concreteness and type of action. A holistic process model to develop a business case, including drivers, benefits and related costs and risks.	Relevant due to the distinction by level of concreteness, from financially calculable to merely observable benefits. Relevant because of the general consideration of various aspects that must be taken into account in a technology business case.
Business case research framework (BCRF)	Maes et al. (2014)	A framework constructed from a literature review, to analyse IT investment-related business cases.	Highly relevant, since references from 169 publications referring to business cases were thematically categorised into dimensions and sub-dimensions with findings.
Conceptual model of organisational adoption	Holotiuk and Moormann (2018)	A model to analyse technological adoption of BCt in organisations.	Less relevant because although BCt is considered, the focus is technological adoption, not business cases.

Table 12 Overview of considered models and frameworks

From all of the considered models and frameworks, we consider the BCRF by Maes et al. (2014) to be the framework most closely related to a potential framework to analyse BCt business cases. Accordingly, based on our findings in Chapter 4, we analyse the BCRF in detail, explaining the areas which corresponded to the results of our inductive analysis of BCt business cases and the areas of divergence. The chapter ends with a summary of our analysis and a concluding answer to our first research question.

5.1 The Most Closely Related Existing Framework

As our literature review in Section 2.2 revealed, there is "*no single right outline, format or content list*" (Schmidt, 2003, p. 1) of what exactly a business case should contain. In the IS space, it is generally recognised that a business case is a structured overview of characteristics that describe IT investments beyond a quantification of their financial benefits, including descriptions, assumptions, cost and benefits, as well as risks or other qualitative and quantitative factors (Gregor et al., 2006; Maes et al., 2014; Ward et al., 2008). Under consideration of the models and frameworks in our literature review and our findings as presented in Chapter 4, for three reasons, we consider the BCRF to be the most closely related existing model or framework to analyse BCt business cases (Maes et al., 2014).

The first reason is that the BCRF focuses on the analysis rather than the development of business cases. In comparison, the framework and model developed by Post (1992) and Ward et al. (2008) were directed more towards aspects that should be included to conduct a successful IT investment using a business case framework and approaches to building a business case, respectively. Whilst both frameworks may also be used to analyse existing business cases, the BCRF offers a thematic structure to analyse existing business cases, rather than a structure or approach to develop a new business case.

The second reason is that the BCRF is dedicated to business cases in the information technology context. Considering the wider spectrum of business frameworks and models, such as business model frameworks and technology acceptance and adoption models, the BCRF is one of the few frameworks that explicitly focuses on the unit of analysis, namely the business case, whilst focusing on IT.

Finally, the third reason is that the BCRF is grounded in literature. It is a framework based on an arguably exhaustive literature review of the keyword "business case" up until 2011. Maes et al. (2014) collected business case references and thereby created a structure

with which aspects of business cases could be classified. In this way, the authors contributed not only by finding relevant references but also significantly with their analytical categorisation and creation of a tool with dimensions, sub-dimensions and findings incorporating and reflecting a wealth of earlier research on business cases.

5.2 Suitability of the BCRF

Given our conclusion that, from all of the existing and analysed models and frameworks, the BCRF is most closely related to a framework dedicated to analysing BCt business cases, we now direct our attention to the BCRF and its suitability for evaluating BCt business cases in the light of our findings.

It is important to point out an underlying difference between our research goal and that of the BCRF's authors. Maes et al. (2014) sought to specify a clear definition of a business case to reveal its impact on IT investments. Therefore, the authors logically placed the business case at the centre of their framework, seeking to find and generalise concepts concerning the business case. Figure 11 illustrates the BCRF with its main and sub-dimensions.

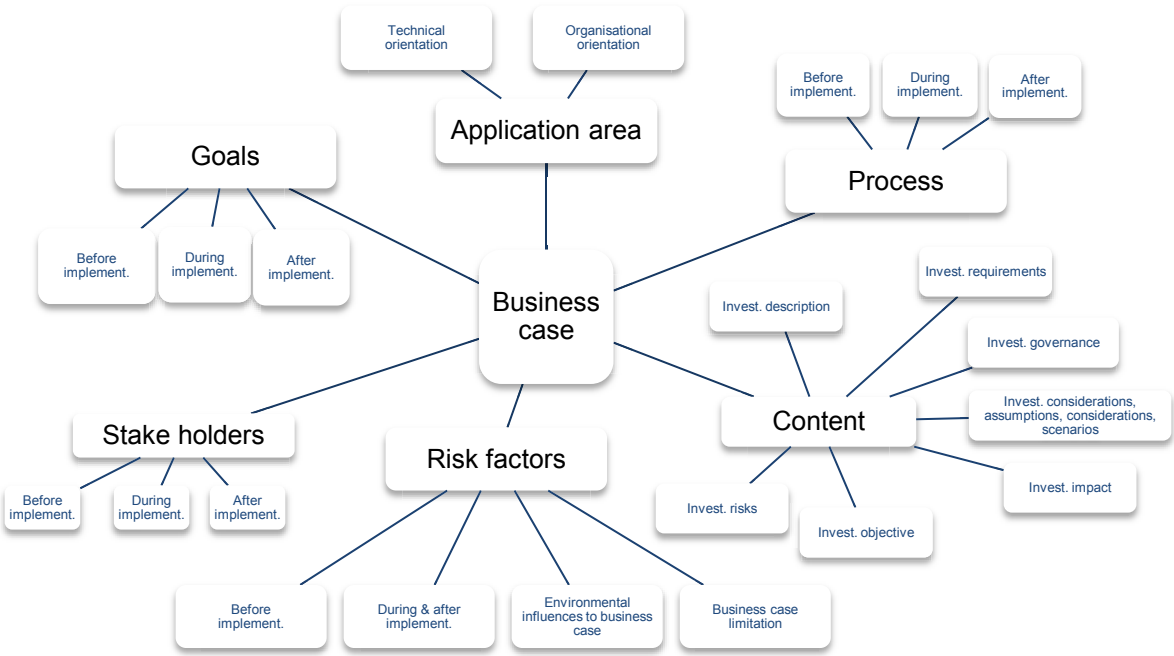

Figure 11 Main and sub-dimensions of the BCRF (Maes et al., 2014)

In contrast, our goal was to explore which key aspects were considered in specific BCt business cases and to develop a conceptual framework thereof. Despite a shared focus on business cases, our GT data collection and analysis resulted in the emergence of a

different perspective. Rather than the business case per se, we found that all the aspects considered in the business case actually related to specific application areas of the BCt. Accordingly, in a framework for the analysis of BCt business cases, as we will explore in Chapter 7, we suggest that the business case would not exist as a dimension. This divergence in research perspective and focus is a reoccurring difference that will be seen in the course of the following analysis of all parts of the BCRF. We thus contribute by deepening the level of analysis concerning a specific subject matter of business cases, rather than business cases per se, which Maes et al. (2014) have compellingly done. We summarise the main dimensions of the BCRF with representative examples in Table 13.

Main Dimension	**Business Case Research Framework (BCRF; Maes et al., 2014)**
Application area	Categories of IT ventures for which the establishment of a business case is advantageous. Examples: • **Data warehousing** • **Gender diversity**
Content	Generalised headlines of content relating to business case investments. Examples: • **Performance targets** • **Resource requirements** • **Risk management plan**
Process	So-called “tasks” (i.e. activities that were mentioned in the literature as part of the process of conducting business cases). Examples: • **Identification** of business drivers • **Estimation** of costs and benefits • **Monitoring** and evaluation
Goals	Goals of a business case (i.e. rationales for the development of a business case). Examples: • **Convincing** people for approval • **Obtaining** additional resources • **Facilitating** a post-evaluation
Risks factors	Risk factors and the potential impact from them. Examples: • **Poor presentation** of the business case, potentially resulting in an “IT-doesn’t-matter” attitude • **Irregular review**, with the potential result that findings are not collected and understood
Stakeholders	A catalogue of the stakeholders that are engaged in business cases. Examples: • **Senior management** • **Finance organisation** • Post-implementation **review team**

Table 13 The business case research framework summarised (Maes et al., 2014)

In the following sections, after a brief explanation of the BCRF's dimensions, we relate these to our findings, explaining their similarities to and differences from the BCRF's main dimensions, sub-dimensions and findings.

5.2.1 Application Area

The BCRF identified the application area as a business case dimension and established sub-dimensions to categorise business cases depending on their application area, either technologically or organisationally orientated. Categorised under these sub-dimensions, the BCRF clustered different software business areas for which business cases were mentioned in the literature. Examples include e-health records and quality management. Comparing these examples to the categories, concepts and dimensions that emerged in the coding process of our inductive analysis, we too saw the emergence of application area as a **main dimension**. However, rather than implying application areas of business cases as such, our dimension refers to specific application areas of BCt in the security settlement space.

The two **sub-dimensions** developed by the BCRF, namely technological and organisational orientation, were consequently more general than the concepts that emerged in our data analysis. All four application areas that we found were primarily based on the utilisation of software and infrastructure. Therefore, they would have fallen within Maes et al. (2014) definition of technological orientation. In comparison, our **findings** specified more particular uses of BCt in the analysed business cases, with specific descriptions, assumptions and advantages.

5.2.2 Content

The content dimension of the BCRF was divided into sub-dimensions to structure so-called "*content elements*" (Maes et al., 2014, p. 49). Examples of sub-dimensions were investment description, investment objectives, investment requirements and investment risks; respective examples of findings were project description, performance goals, resource requirements and a risk management plan (Maes et al., 2014).

A content dimension did not emerge in our coding process. In our interpretation, this is logical given the above-mentioned underlying difference in research goals. Whereas business case content in the BCRF refers to the content included in business cases in general, our aim was to analyse the content of a few considered BCt-related business cases. Indeed, the **sub-dimensions** and corresponding **findings** of the BCRF, as exemplified above, corresponded to the concepts and categories that resulted in our application area dimension.

5.2.3 Process

Under the process dimension, the BCRF listed a number of “tasks”, which are activities that were mentioned in the literature as part of the process of conducting business cases. They were organised chronologically in the following stages: before, during and after implementation. Examples include identification of business drivers, estimation of costs and benefits, and monitoring and evaluation, respectively (Maes et al., 2014).

A process dimension and chronological concepts before, during and after business case execution emerged from our coding process, coinciding with the **main dimension** and **sub-dimensions** of the BCRF. Therefore, on this point, we find a strong parallel between our conceptual findings and the BCRF.

Considering the process **findings**, again there exists a difference in the angle of consideration relating to BCt-specific processes. The BCRF grouped different process tasks concerning business cases as such and in general, such as the subject of approval (before implementation) and evaluation (after implementation) of business cases. In contrast, the process categories that resulted from our coding process were specific to BCt business cases. For instance, we found that the funding of business cases, including any financial calculations and approval thereof, occurred before and during business case execution. In comparison, funding was found to be part of the business case content in the BCRF. Again, this highlights how the scope of the BCRF concerns business cases as such.

5.2.4 Goals

The authors of the BCRF defined goals as a collection of rationales for why a business case should be developed. Examples include convincing people, obtaining additional resources and facilitating evaluation (Maes et al., 2014).

As demonstrated in Section 4.3 (page 70) our open, selective and theoretical coding also resulted in the conceptualisation of a dimension called goals. However, the **main dimension** of the BCRF focused on goals from the perspective of a business case itself, in general, rather than on the goals of a particular business case’s subject matter. This conceptual divergence between the BCRF and our findings is further evident in the lower level of sub-dimensions (i.e. our concepts).

The BCRF structured the goals dimension into the **sub-dimensions** “before implementation”, “during implementation” and “after implementation” of the business

case (Maes et al., 2014), whilst our coding process revealed 20 thematic rather than chronological categories and 10 concepts thereof. Once again, this points to the underlying difference in perspectives, given that Maes et al. (2014) considered a large number of unrelated business cases, with the aim of collecting **findings** to abstract the goals of business cases as such. In contrast, the goals that emerged in our data analysis were goals for the use of BCt in particular application areas.

5.2.5 Stakeholders

Maes et al. (2014) defined stakeholders as the people who can or are themselves impacted by the business case, who are somewhat responsible for its implementation and who are interested in its success (Maes et al., 2014). This interpretation is supported directly and indirectly by various references to content-relevant literature, which cites examples such as "*partners*", "*shareholders*", "*strategists*", "*clients*", "*business process designers*" and "*communities*", referring to one or more actual persons (Dyllick & Hockerts, 2002, p. 131; Osterwalder, 2004, p. 3).

Accordingly, the BCRF's **main dimension** – business case stakeholders – is a catalogue of the people who are engaged in the business case per se, sub-divided into before, during and after implementation. Examples are senior management, an organisation's finance department and a post-implementation review team, respectively. Our coding also culminated in a stakeholders dimension, most likely because financial services and information technology are ultimately based on human capital (i.e. people and their skills).

The BCRF structured the stakeholders dimension in the chronological **sub-dimensions** before, during and after implementation of the business case, dissimilar to our results, where a thematic structure of internal and external stakeholders emerged. As for the **findings**, the stakeholders were similar despite the BCRF's aim to generalise stakeholders for a large number of contextually unrelated business cases and our aim to consider BCt-specific business cases. Interestingly, Maes et al. (2014) appear to have found only stakeholders that we conceptually assigned to our concept "internal stakeholders". A key external stakeholder that was found in BCt business cases was the financial regulatory body.

5.2.6 Risks

The argument proposed by Maes et al. (2014) is that unless an organisation builds a business case adequately, "*unidentified risks may negatively impact the investment*

outcome" (Maes et al., 2014, p. 53), which are subsumed under the **main dimension** business case risks.

The authors structured their findings regarding both the risk factors and the potential consequences thereof in the **sub-dimensions** before, during and after implementation, environmental influences and business case limitations (Maes et al., 2014). Examples include the poor presentation of a business case; irregular review of a business case, with the potential consequence that findings are not collected and understood; and influences by organisational culture, with the potential result of varying business case quality (*ibid.)*.

The coding and interpretation of our interviews revealed a number of specific risks, and we thus also conceptualised risk factors as a dimension. However, once again, there exists an important difference in perspective, evident in the consideration of the sub-dimensions and specific **findings**. The authors of the BCRF focused on collecting risk factors inherent in business cases themselves. To exemplify, one of their findings was the risk that a business case is not being presented in a comprehensive manner, for example because of language barriers, with the consequence that certain stakeholders do not fully understand the objectives (Maes et al., 2014). In contrast, our GT analysis returned concepts of risks that are most predominantly related to the use of BCt. For instance, we found the risk to BCt business cases resulting from the regulatory and legal uncertainty surrounding the use of BCt in the settlement of financial securities.

5.3 Research Question I: Key Results

In this chapter, we first revisited the technology frameworks and models that we had initially considered as part of our literature review. In answering our first research question (what existing models and frameworks are available to analyse technology business cases, and how suitable are they to evaluate BCt business cases?), for three reasons, we decided that the BCRF by Maes et al. (2014) was the most closely related framework. First, it analyses existing business cases; second, it focuses on business cases within the IS space; and third, it is founded on existing literature.

Under consideration of our findings in Chapter 4, we evaluated the suitability of the BCRF to analyse BCt business cases. Most importantly, we found that there existed a divergence in perspective between our conceptual findings and those of the BCRF. Whereas the BCRF places the business case as such at the centre of its framework, our

findings conceptually resulted in our understanding that the application area for which BCt is being used is at the centre of a particular business case.

At the highest level of abstraction, the **main dimensions** application area, process, goals, risks and stakeholders corresponded to the dimensions that emerged from our coding. This is not surprising given the shared focus of IT business cases. However, even at this highest level, there were differences. Descriptive aspects of the business cases, grouped into the content dimension of the BCRF, emerged as part of our application area dimension. Furthermore, our coding resulted in a dimension, environment, which as such does not exist as part of the BCRF.

The divergence in focus between the BCRF and our results became further evident at the BCRF's level of **sub-dimensions**. Here, a parallel existed only for the main dimension process, where both the BCRF and our results followed a similar chronological structure: before, during and after what Maes et al. (2014) termed "implementation". For all other dimensions, our concepts were more thematic, whereas the BCRF predominantly followed a chronological structure.

This divergence in perspectives was most apparent under consideration of the lowest level of abstraction, namely the **findings** presented by Maes et al. (2014) for each of their sub-dimensions in comparison to the categories presented in our findings in Chapter 4. As explained in several instances, the focus of the BCRF was on the business case itself, such that, for example, the goal of the business case is to improve communication. In contrast, the focus of our inquiry was on identifying the specific aspects of BCt business cases that were considered, such that, for instance, the goal of cost reduction through the employment of BCt emerged.

We consequently conclude that the BCRF is a valuable tool for the consideration of technology business cases as such and in general. It offers a framework based on a comprehensive literature review and includes an equally comprehensive list of particular findings that may, in many cases, apply to BCt business cases as much as it would for any other technology business case. However, it is not the aim of the BCRF, nor of any of the other considered models and frameworks, to focus on the purpose of implementing (i.e. planning, executing and evaluating) particular BCt business cases. We suggest that a framework dedicated to this purpose could be more specialised and thus more suitable.

Finally, the question may arise as to whether our conclusion about the BCRF's suitability applies only to the BCt business cases considered as part of our study or whether our conclusion may apply to a potentially wider spectrum of BCt business cases beyond the security settlement area and potentially even beyond the realm of finance. Our conclusions about the applicability of the BCRF are based on our comparisons and contrasts between the dimensions, sub-dimensions and findings of the BCRF on the one hand and the dimensions, concepts and categories that emerged in our qualitative inquiry on the other.

However, for the following reasons, our findings may be applicable beyond the analysed business cases. First, our theoretical sampling strategy naturally resulted in a relatively wide spectrum of business cases, and we hence covered a wide range of situations within the security settlement space for different kinds of financial institutions. Second, we would suggest that the differences in perspectives between the BCRF and our research inquiry may indeed warrant a wider applicability of our conclusions. In all of the considered business cases, not the business case as a vehicle, per se, but the BCt was the matter of concern. Finally, the fact that business cases were predominantly informal and undocumented supports this point, since it was not the formalities of the specific business cases as such, but their subject matter that was important.

Considering the reasons for the informal and undocumented nature of the encountered business cases, we would suggest that the relatively nascent stage of BCt and the high level of uncertainties inherent in it, both on a technical and a regulatory level, may be an important factor. Given these uncertainties, arguably, not the business case as such but the technology and emerging business environment surrounding it, take the predominant role within the business cases. Although we would hope for this argument to be scrutinised by follow-up studies, we could imagine that it applies to BCt beyond the realm of security settlement and potentially beyond the financial industry. With increasing maturity then, the assumption that BCt business cases can be expected to align with any other technology business cases, could be tested in future research. From our qualitative study only, we would suggest that the unique aspects of BCt will render BCt business cases as special technology business cases or at least slow down this alignment.
Implementing BCt involves more than changing an internal IT infrastructure. It both requires and allows for radical changes to take place within an organisation and even beyond, at an industry level. As a consequence, from a practical point of view, a business case based on formalistic procedures, with the expectation to plan and calculate the

technological development, implementation and all iterations and changes thereof, appears more prone to failure than a more flexible approach.

Arguably then, even at a later, more mature stage of BCt and its regulatory environment, the impact of the technology will be likely to depend on specific industry and organisational aims and conditions. Accordingly, a BCt business case will likely focus on the technology and the areas that are comprehendible and computable with some certainty, depending on each specific situation. A business case framework will hence be more adept at analysing and equally assisting the development of new BCt business cases if it provides guidance tailored to the specific aspects of BCt. Based on this guidance, agile approaches of BCt implementation appear to be most promising.

6 Aspects of BCt Security Settlement Business Cases

In the introduction to this dissertation, we explained the phenomenon that BCt is being implemented for the security settlement process of financial securities, and we formulated our research goals and questions to explore this phenomenon inductively (Chapter 1) using a grounded theory methodology (Chapter 3). In our literature review (Chapter 2), we considered existing models and frameworks potentially suitable for analysing BCt business cases, and we considered them in the light of our findings (Chapter 4) in the first part of our evaluation (Chapter 5). We concluded that although the BCRF is a highly valuable basis, we sought to develop a framework more specifically for BCt business cases. In this chapter, we now turn to our second research question:

> *Research Question 2*
> *Which key aspects did financial institutions consider in their business cases to implement Blockchain technology for their security settlement?*

This chapter is structured according to the six main dimensions that emerged from our GT coding process, as presented in our findings in Chapter 4. We evaluate our findings, constructing arguments and interpreting the data in an amalgamation with the literature, following GT techniques (Bryman, 2016, pp. 378-379; Charmaz, 2014, pp. 285-286). On a first level, we search for patterns within and across the dimensions. On a second level, we strive to "*synthesise*" (Patton, 2014, p. 541) the findings from our interviews with existing, related literature to interpret their meaning.

6.1 Application Area

Across all interviews, participants declared BCt to be a "*fantastic technology*" (I), which is considered to have a "*significant impact* […] *especially in the post-trade*" (I) given that "*this business is zero-value-adding activity for clients, and as such, margins are extremely low*" (I). Indeed, for at least the past four years, there has been widespread consensus about potential application areas of BCt in the finance sector and beyond (Crosby, Pattanayak, Verma, & Kalyanaraman, 2016; Mohanta, Panda, & Jena, 2018). Honing into our field of interest, application areas of BCt were identified in the space of banking (Guo & Liang, 2016; Konstantinidis et al., 2018), financial transactions (Labazova, Dehling, & Sunyaev, 2019) and, concerning our specific focus, also for the settlement of financial securities (ECB, 2021; Mills et al., 2016; Schuster et al., 2020).

6.1.1 Use of Blockchain Technology

Our coding resulted in the distinction of four application areas of BCt in the space of security settlement. BCt-specific application areas in the academic literature include those both in the financial domain, such as "*financial services*", "*financial transactions*", "*banking*", "*cryptocurrencies*", "*insurance*" and "*private securities*", and in non-financial areas, such as "*healthcare*", "*real estate*", "*supply chain*", "*energy*", "*the music industry*", "*notary public*", "*smart contracts*", "*storage*", "*communication*" and "*voting*" (Crosby et al., 2016, pp. 13-16; Konstantinidis et al., 2018, pp. 387-390; Labazova et al., 2019, Table 1; Laroiya et al., 2020, pp. 220-224). All of the application areas that emerged in our coding process would fall either into a sub-category "*clearing and settlements*" as a sub-category of "*financial services*" (Laroiya et al., 2020, p. 221) or into "*capital market operations*" as a sub-category of banking, as suggested by Laroiya et al. (2020, p. 222).

Another distinction is made between assets that exist outright, only on-ledger, and those assets with a dual existence, on-ledger and backed by an off-ledger counterpart (Hileman & Rauchs, 2017; Niu, 2018; OECD, 2020). In the first case, the asset that only exists on-ledger is referred to as a "*digital asset*", "*native to the Blockchain*", or a "***native asset***"; in the second case, assets that exist off-ledger are mirrored by an on-ledger proxy and are referred to as "*digital representations of physical assets*" or "***non-native assets***" (BIS, 2017, p. 3; Hess & Spielmann, 2017, p. 151; Hileman & Rauchs, 2017, p. 18; OECD, 2020, p. 12).

Native assets are sometimes referred to as "dematerialised", whereas for non-native assets, the analogy of "securitisation" is appropriate. Both terms have existed long before BCt. On the one hand, dematerialisation means that for an asset, shares and debt certificates, for example, no longer exist in paper-based form but are immobilised and only exist as book entries at an intermediary such as a broker or central securities depository (CSD). On the other hand, securitisation is a process of issuing securities that derive their value from an underlying asset and the legal rights to its cash flows (Loader, 2019, p. 248; OECD, 2020), commonly known as "asset-backed securities" (ABSs).

This differentiation between native and non-native assets is in line with our findings in the business cases we analysed. Thus, we interpret them in Section 6.1.2 unterhalb, distinguishing between business case application areas in which BCt was used for the settlement of **native assets** – "*a purely digital security, so it wasn't tokenised; it was issued digitally. So it was 'dematerialised'*" (III) – and **non-native assets** "*like shares of an SME or bonds of a small organisation and all financial products related to those basic*

products and also the tokenisation of diamonds and gold and so on – up to intellectual property." (X)

Tokenisation is a term frequently used in this context, and indeed some of our interviewees were engaged in BCt relating to tokenisation. In our view, whether the asset is referred to as a token or not is in fact nomenclature, almost entirely dependent on the meaning defined by the given jurisdiction (Hess & Spielmann, 2017, p. 168). Furthermore, the exact meaning of a token, and hence the ascertained rights and underlying value, is ultimately a matter of legal definition, which depends on the national jurisdiction under consideration; this is equally true for the process of tokenisation (BIS, 2017; Priem, 2020).

In our categorisation, we focus on whether the assets that are settled are native or non-native to the Blockchain, and we create two sub-dimensions of application areas, as listed in Table 14. Detailed descriptions of these follow in the subsequent section.

Concept	Summary of evaluation
Use of BCt	**Native assets** 1. Bilateral security settlement between organisations 2. Capital raising 3. Creation of a secondary market **Non-native assets** 4. Internal organisation

Table 14 Summary of evaluation: Application area – use of BCt

6.1.2 Description

In our coding process, the concept "description of the application area" emerged. The four different uses of BCt and a description thereof are summarised in Table 15.

Concept	Summary of evaluation
Description *(of the four uses of BCt)*	1. Delivery versus payment (DvP) of digital security vs. digital cash 2. Streamlining the process of primary issuance 3. Creating liquidity 4. Smart-contract real-time batch processing, standardised trusted documentation, risk management

Table 15 Summary of evaluation: Application area – description

The first application area we evaluated is the bilateral security settlement, which can be described as a **DvP of digital securities vs. digital cash**: "*a DvP trade or the deliver versus payment as a simple contract call*" (VIII) can take place on-ledger, and "*you no longer have the secondary/primary market […]. You only have a market, no dealer and no security on our books"* (III). Such an application area is well known in finance and technology and is often referred to as a "*financial transaction*" and, more specifically, as "*securities trading*"; "*clearing and settlements*"; or "*security, commodities and derivatives transactions*", where post-trade processing, ranging from trade execution to settlement, can benefit from an asset exchange on an immutable digital ledger without any intermediary (Konstantinidis et al., 2018, pp. 387-389; Labazova et al., 2019, Table 1; Laroiya et al., 2020, pp. 220-222; Mills et al., 2016, pp. 17-18).

The second application area we evaluated is capital raising, which was described as **streamlining the process of primary issuance** with the purpose "*to issue tokenised equity*" (VII), which is "*akin a depository receipt – it's the title that represents the beneficial interests […]"* (VIII). In line with literature on this topic, the content of this business case aimed to use BCt for a primary issuance. Native tokens – in this case, companies' equity – were logged on the Blockchain without the asset-backing existence of an off-chain asset, which would otherwise have to be dematerialised, represented and held in custody (Crosby et al., 2016; OECD, 2020). We explained the difference between native and non-native assets in Section 6.1.1, above.

In theory, this process could also work for the issuance of other financial instruments. It seems reasonable to consider primary issuance as part of our research focusing on settlement, given that settlement constitutes a significant part of primary issuance as in the case of an IPO (SMPG, 2015). Furthermore, the potential of BCt in relation to the settlement process of a primary issuance has been recognised in theory, and actual use cases exist, such as NASDAQ Private Market (Crosby et al., 2016; Laroiya et al., 2020; Mainelli & Milne, 2016; Prisco, 2015).

The third application area we evaluated is the creation of a secondary market, which can be described as the **creation of liquidity**: "*The whole benefit of tokenisation is global liquidity*" (VI). Although greater liquidity is a recognised potential of BCt, not only amongst academics (Paech, 2016; Yermack, 2017) but also amongst business practitioners (Lord et al., 2017), we are cautious to accurately distinguish between the different application areas. BCt applied to facilitate settlement, starting with an issuance of native tokens, indeed has the potential to create "*liquidity potential and tradability of assets with near-*

absent liquidity" (OECD, 2020, p. 3), and it was interesting to observe how central this point was for the rationale of the entire business case considered in our research. However, where BCt is applied to settle existing securities, there are in fact arguments against an increase of liquidity (Manning et al., 2016), since the settlement cycle is shortened, potentially to instantaneous settlement. Such an elimination of the netting process in pre-settlement and its effects on market liquidity are debated and subject to further and detailed assessment (Pinna & Ruttenberg, 2016).

Regarding the fourth application area we found, namely internal organisation, the assets that are logged on-chain are non-native proxies to the Blockchain: *"You can actually build a smart contract to reflect the derivative"* (II). This system allows for almost **real-time queries** of current value and value at risk (VAR), thus enabling more current risk reporting and management: *"at any point in time, you can go away and grab the data and update the value of that particular contract without having to update and process all these different derivative contracts"* (II).

Smart contracts are essentially algorithms embedded within the Blockchain – in other words, software programming that is coded in the blocks of the chain and can therefore not be changed subsequently (Priem, 2020; Schuster et al., 2020). The use of smart contracts is widely recognised to embed automatic processes within the chain, for example to trigger events when certain conditions are met (Laroiya et al., 2020) effectively in the form of on-chain applications (Kher, Terjesen, & Liu, 2020).

Although smart contracts and "*the use of the Blockchain in post-trade […] for the maintenance of a single, shared, immutable ledger of transaction information"* (OECD, 2020, p. 32) have been recognised, our finding of a purely internal company setting is novel given that BCt is typically applied to establish a network of participants who would otherwise not directly trade with one another due to a lack of trust. The closest description to the encountered use of BCt is so-called "*bookkeeping and auditing*" by Laroiya et al. (2020, p. 221), describing improvements in company external auditors' access to and validation of financial statements. Furthermore, Labazova et al. (2019) describe data management as an application area for sharing economies and enterprise asset management "*to keep information confidential*" (Labazova et al., 2019, p. 6), which also relates to a set-up between several participants rather than an inter-company set-up.

The literature does not seem to describe the use of smart contracts to reflect financial derivative contracts and to facilitate their administration or arguably internal company "settlement" between various employees and departments. Indeed, here certain derivate calculations, which would have previously been embedded, for example, in spreadsheets in the form of VBA (Visual Basic for Applications) macros, prone to errors and alterable, are now effectively immutable as smart contracts coded on the chain. We consider that the use of BCt in this application area ensures a sense of longitudinal interdepartmental credibility in the form of **commonly accepted documentation**, which is trusted regardless of staff and management fluctuations over the course of years.

6.1.3 Advantages

We found "advantages" to be a concept for evaluating one key advantage for each of the four application areas in comparison to the status quo of technologies and processes in place. We are aware of a potential overlap with our goals dimension. Indeed, business cases' goal to implement BCt largely relies on the (potential) advantages of BCt. In this section, we focus on evaluating the advantages of implementing BCt in comparison to the status quo, as summarised in Table 16, rather than the goals of implementing it.

Concept	Summary of evaluation
Advantages *(of BCt vs. the status quo)*	1. Trust is created between parties that do not trust one another 2. Reduction in transaction costs of fractionalising an asset 3. Common shared trading infrastructure with fewer required intermediaries 4. Optimised internal processes with i) fewer process steps ii) enhanced transparency thanks to real-time queries iii) more organised communication

Table 16 Summary of evaluation: Application area – advantages

For the first application area, <u>bilateral security settlement</u>, we found that the need for fewer intermediaries in the security settlement process, at least for the majority of stakeholders, was the most significant advantage. We consider this to be a consequence of the **trust created between transaction parties** using on-ledger settlement: " […] *those that require, in this process to trade, to trust each other* – which *they don't – but they interoperate* […] *terribly easily, cheaply across the globe.* (VIII). Indeed, a central element of the Blockchain since its inception is the ability of BCt to establish a shared bookkeeping system, which is trusted by transacting parties thanks to underlying cryptography and resulting immutability of the ledger, thereby obsoleting so-called

trusted third parties (Nakamoto, 2008). However, there also exists a viewpoint that intermediaries will remain in existence, albeit with different functions.

The role of intermediaries, including banks, broker-dealers and financial market infrastructures (FMIs) such as CSDs and CCPs will almost certainly change (Mills et al., 2016): "*So of course, for cutting the pizza and reselling it, we won't get the money anymore, but we do a lot of things besides as a service, […] and this service will be priced explicitly so you could ask, for example, for KYC as a service, for AML conformity as a service, for sanctions or checks, regulatory reporting, whatever, as a service"* (III). To sum up the argument, the automation of certain tasks can be seen as an advantage, with the potential of saving some intermediate processes altogether and the possibility to free non-value-adding resources.

Pertaining to the second application area, capital raising, we consider the **reduction in transaction costs in the process of fractionalising an asset** to be the key advantage of using BCt in regard to the security settlement process. A reduction in transaction costs thanks to fewer intermediaries and hence fewer process repetitions in the settlement process has been identified, as has the application of BCt for primary issuance and the fractionalisation of assets (Crosby et al., 2016; Priem, 2020). Arguably the high degree of automation and efficiency in the issuance process are underlying prerequisites for the emergence of security token offerings as well as the preceding initial token offerings (Mazzorana-Kremer, 2019). Whereas fractionalising of assets can also take place for existing assets, for example through the issuance of non-native tokens, this was considered to be "*[…] a moot point. There's no reason for you to tokenise a security for tokenising a security"* (VIII), because a settlement of the security against cash would be possible without the process of tokenising first. The real benefit was seen in allowing for "*cheaper, faster […] issuance and eventually secondary trading"* (VIII) for otherwise large lot-sized, illiquid assets.

For the third application area, creation of a secondary market, described earlier as "creating liquidity", one interviewee succinctly expressed the advantage, of the **creation of a "*common shared infrastructure*"** (VIII), which allows several parties to interoperate at low cost and across borders, using an infrastructure that adequately substitutes for their lack of trust. This appears to be a critical advantage of BCt for assets such as SME equity, where transaction processes (e.g. legal ownership contracts) are rarely standardised and therefore are commonly more illiquid and more expensive to value than, for example common equity is.

The issuance of native assets based on standardised terms and conditions allows for a complete documentation of the track record of the on-chain assets, with fewer intermediaries and fewer manual administrative processes required in the settlement process (OECD, 2020). Transactions involving these assets are consequently faster and incur little to no transaction costs. This, in turn, should motivate investors to trade their investments more frequently, thus theoretically increasing market liquidity. Higher market liquidity has been found to have positive effects on price discovery in a market (Brogaard, Hendershott, & Riordan, 2014; OECD, 2020). Although this does not imply a more accurate valuation of the underlying asset, it does allow for a more up-to-date market-to-market price.

For the fourth application area, internal organisation, we considered the **optimisation of internal processes** as the key advantage, and we broke this down into three legs. The first one is **fewer required processes** to settle a trade within an organisation of a transacting party: "*we had 52 […] intermediary steps, like issuance, trade offering and trade acceptance, trade execution, maturity execution […] and for this process, now we are at 13 steps!"* (III). This confirms and specifies statements by Laroiya et al. (2020) about the ability of BCt to render business processes more efficiently, securely and transparently.

The second advantage, **enhanced internal transparency and real-time queries**, significantly contributes to optimised internal processes. For this, the coding of derivative structures in smart contracts plays an important role. Comparing this with the amount of time, additional effort and risk of subsequent manipulation that such calculations would otherwise incur and be prone to, we consider these efficiency and security gains as a significant advantage of BCt. Our findings substantiate general acknowledgements about the ability of smart contracts to execute financial products autonomously (Yermack, 2017). This is increasingly observed in automated payment processes, with bond coupon payments being one of several examples within the finance sector (Cohen, Smith, Arulchandran, & Sehra, 2018) and also related to security settlement execution for the custody layer (Pinna & Ruttenberg, 2016).

The third advantage is the more structured, **organised communication** supporting internal optimisation. Through the use of BCt, a universal and immutable reference point is established in an organisation. In the past, within one organisation, there were different data silos, such as traders, accountants and legal departments, each holding pieces of

data concerning specific transactions, and it was possible to change (i.e. manipulate) data retrospectively. In contrast, BCt offers an efficient structure of internal document management: "*[…] the 'immutability' of the Blockchain system meant, if you looked at that particular transaction, you've got everything related to it"* (II).

6.1.4 Assumptions

In our evaluation, we focused on two of the found assumptions, as summarised in Table 17. In different ways, both apply to all four application areas. We subsumed three of our findings – namely that cost savings can be materialised, that BCt is scalable and that a market exists for the BCt-based solution – to evaluate the assumption of the **existence of commercial value** in a BCt-based solution. For the application areas bilateral security settlement and creation of a secondary market, commercial value relied on the potential to reduce operational costs by reducing the number of intermediaries in the settlement process: "*there was this assumption that the technology could replace intermediaries"* (IV).

Concepts	Summary of evaluation
Assumptions	1. There is commercial value in BCt-based applications. 2. The BCt-based application is approved.

Table 17 Summary of evaluation: Application area – assumptions

The reduction of intermediaries is a frequently cited potential of BCt, for example in relation to a reduction and streamlining of processes in securities' clearing and settlement (OECD, 2020; Priem, 2020), a cost reduction in healthcare (Laroiya et al., 2020) or the use of smart contracts for real estate transactions (Mohanta et al., 2018).

Similarly, for the application area internal organisation, commercial value was based on cost potentials through the automation of manual internal processes in line with general descriptions about BCt potentials, for example as outlined in a government report (Science, 2016). For the application area capital raising, the business case assumption of commercial value related to the existence of an underlying market for the BCt-based securities: "*because even though it's innovative, if it's not commercial, there's no point"* (VII), meaning that unless there was demand from investors for the native securities issued on the Blockchain, the higher efficiency of the BCt-based issuance process would be irrelevant. These findings suggest that one of the most important assumptions underlying BCt business cases in the settlement domain was commercial value based on the reduction of operating cost.

The second assumption we considered was the **approval of the BCt-based solution**. Here, we identified a difference between the three application areas where assets native to the Blockchain were involved (security settlement, capital raising and creation of a secondary market), versus the application area where assets were non-native to the Blockchain (internal organisation). Business cases with application areas involving assets native to the chain, were based on the assumption that approval from the governing regulatory authority could be obtained.

In the case of bilateral security settlement, the transaction involved a bilateral transaction and legally originated in a jurisdiction permitting a dematerialised transaction to take place. The assumption of regulatory approval was less critical, which seems logical, as the transaction was bespoke between two equally informed parties without asymmetries of information. For the application areas of capital raising and the creation of a secondary market, however, the assumption of regulatory approval appeared to be critical, which is understandable given the heightened attention of regulators concerning anything in relation to the buzz words “Blockchain” and “tokenisation” and the amount of past fraudulent activity in this area.

Seventy-eight per cent of initial token offerings measured by quantity and approximately 11% by $ volume issued, were found to be illegal up to July 2018 (Dowlat & Hodapp, 2018). In both cases, namely capital raising and trading via a secondary market platform, investors must rely on publicly available information about the underlying assets, which in the past was often incomplete or false, with regulators challenged to close this regulatory gap (Zetzsche, Buckley, Arner, & Föhr, 2017).

For the application area internal organisation, the assumption of obtaining approval did not relate to regulatory approval directly, but rather internal approvals: “*The actual code and software had to all be equivalent to their existing standards […] and go through their software auditing procedures*” (II). From this evaluation, we conclude that any assumptions should be specific to the application area. We propose that the assumption of approval relates to regulatory approval, especially where infrastructure is established to facilitate trading and settlement between transaction parties with large asymmetries of information. Where BCt is applied in an internal context, regulatory approval is likely to be significant less directly and less than internal approval.

6.2 Process

There exists a common understanding that the planning, execution and evaluation (i.e. the implementation) of a business case take place as a process (Maes et al., 2014; Sarkis & Liles, 1995). We evaluate our findings before, during and after execution, referring to the three stages of implementation: planning, execution and evaluation, respectively.

6.2.1 Before Execution

For the concept "before execution", we evaluated four findings as shown in Table 18. Where applicable, we assessed them in the light of each of the four application areas. The first finding we evaluated is the **design of BCt business cases**. All of the analysed business cases had been designed internally, by a project team or so-called "expert group". The main reason for this was most likely a combination of the objective to build internal competences, as will be explored in more detail as one of the business case "goals", and the unavailability and high cost of skilled human capital: "*It was all internal"* (VII); "*[…] it effectively was a little start-up within the corporate"* (II). These two reasons are in line with our other finding that robust financial calculations and funding based on such calculations were a challenge for all considered business cases, given their exploratory nature, and they had uncertain outcomes. Furthermore, for business cases that took place within a larger organisation, it was interesting that there was no interdepartmental effort, but all the BCt-related work and knowledge was concentrated with one centrally organised team: "*We are the hub for all"* (III).

Concept	Summary of evaluation
Before execution	• Design of the BCt business cases • Style and strategy of BCt business cases • Funding and financial calculations • Education and training

Table 18 Summary of evaluation: Process – before execution

Especially amongst practitioners' literature, there is a clear line of argument that financial institutions are unlikely to invest in BCt unless cost savings within three years are foreseeable (Van Steenis et al., 2016). Some of the business cases we considered were aligned with this, but those that explored the market and technology were not. In such an unclear environment, as we will evaluate in the dimension on stakeholders, the prospect of establishing competences amongst internal staff appeared to be a welcome side-effect in addition to a potentially successful realisation of other more obvious goals.

The **style and strategy** of the business cases constitutes the second finding we chose to evaluate. For the bilateral security settlement application area, the business cases followed an exploratory style of "…*putting in place a small investment to monitor the market, rather than to find the solution"* (I), without a strictly defined, written and calculated business case in place: "*we don't have really something like a paper-based business case*" (III). Such an open and experimental approach was considered as part of a long-term technology strategy where, as previously explained, the fostering of internal staff competencies was also important. Internally, these cases were categorised as innovation projects because of the lack of either regulatory urgency or quantifiable benefits such as cost savings. We identified such an "exploratory approach" in other Blockchain projects, such as for the Swiss stock exchange, which is establishing a completely integrated trading, settlement and custody infrastructure for digital assets (SDX) and will initially start trading only tokenised equity to explore other tradable assets (Insights, 2019; OECD, 2020).

Although this exploratory style also had objectives and goals, as we will analyse in the business case goals, such an open or even vague strategy appears to be unusual in a corporate setting. In their systematic literature review of business cases, Maes et al. (2014) did not find a single reference to "strategy" in the business case process; instead, the authors listed the development of a "*work plan, action plan, roadmaps*" (Maes et al., 2014), which could be interpreted as a type of strategy. For the business cases of the three other application areas, the style was less exploratory. The goals of these business cases impacted their style and strategy, as we will explore further on.

In summary, we suggest that the **style and strategy** of the pre-execution business case process strongly depends on the types of goals that are defined in the business case. We believe that goals such as to "research and explore" a new technology or to "monitor the market" are more likely to result in a more open-style process, whereas measurable targets, such as the "development of an operating system" take place in a more structured process strategy.

The third point we evaluated is that classical financial calculations were recognised in only one of the considered business cases. Classical financial project approval calculations include, for example, return on investment, internal rate of return (IRR) and net present value (Keen, 2011, p. 146; Post, 1992). In fact, such a profitability calculation was performed only for one of the business cases and only because it was a prerequisite to attain regulatory approval. To apply the categorisation of Ward et al. (2008), our

findings revealed that in all but one of the business cases, the implementation process commenced with a low level of "*degree of explicitness"* (Ward et al., 2008, p. 7) of benefits (Figure 4, page 20). This combination of few financial calculations on the one hand and the goal of cost reductions on the other is noteworthy. We will return to this point in our discussion.

Education and training is the fourth point that we evaluated in regard to the process before execution. Establishing internal competences was a goal in all of the business cases, as will be evaluated as part of the goals dimension. It is interesting to analyse because it applies differently to business cases from the various application areas. Where legacy systems were being reformed using BCt, as in the internal organisation application area, we recognised a greater need for education and training. This need extended beyond the project team developing the BCt-based solution to the entire organisation to induce a cultural change that would support the adoption of the new technology: "*it's a systemic change, […] that's very difficult to achieve; that can take, on average, certainly a minimum of 12 months, probably 24 months"* (II). Such an effort to foster technological adoption is commonly recognised as being complicated and costly (T. Oliveira & Martins, 2010; Pan & Jang, 2008) in terms of both commitment to a cultural change (Balser, 2018) and the time it takes, for example 1–2 years of effort required for an ERP implementation (Basoglu et al., 2007).

In contrast, where BCt was used to introduce new infrastructure altogether, such as for the capital raising application area, the need to change legacy culture was less imminent. This was most likely because of the content of the business case, which set out to establish an entirely new infrastructure, and the resulting organisation built around it, with less need to incorporate given systems and culture. Here, education and training focused heavily on regulatory issues, not only educating professionals at the regulator but also "*hundreds of hours educating lawyers"* (VI) as well as internal staff on how "*to present themselves correctly* […] *in front of the FCA*" (II).

To summarise this point, we suggest that education and training is an indispensable part of the business case process, starting even before execution, for example with necessary legal and regulatory preparations. Our findings support common consensus that education and training must take place to foster technological adoption (Holotiuk & Moormann, 2018).

We suggest that where a technological innovation is launched as a stand-alone project or even a start-up enterprise rather than within an existing organisation, there is less need for education and training to integrate the technology within given systems. Instead, in these younger organisations, there seems to be a higher need to offer education on regulatory issues, since a younger organisation may be subject to closer regulatory scrutiny and internal corporate training structures are likely to be less established to build on.

6.2.2 During Execution

Most business case process-related findings concerned the stage "during execution". We evaluated four points here, as listed in Table 19. This section follows the same structure as above, highlighting noteworthy points for the four application areas.

Concept	Summary of evaluation
During execution	• Practical set-up • Performance reporting • Node management - Type of Blockchain applied - Decentralisation of nodes • Challenges - Funding - Integration, interfaces and common standards

Table 19 Summary of evaluation: Process – during execution

The first finding we evaluated is the **practical set-up** of the business cases. All analysed business cases were implemented using some form of ring-fenced structure, such as an incubator, an innovation lab, a project team or a start-up. Indeed, isolating project teams is a well-known corporate strategy to foster internal innovation (Reis, 2011, p. 27), as is the sponsorship of accelerators and incubators (Mills et al., 2016). Together with our prior evaluation, we observed an evolving pattern where business cases that we categorised as application areas in which existing systems and processes are to be advanced or replaced – <u>bilateral security settlement</u> and <u>internal organisation</u> – were carried out in closer corporate proximity. In the first case, projects were launched out of a "*research lab*" (III), and in the latter, an internal project team was created: "*they've actually created their own internal start-up* […]" (II).

Where the focus was less an advancement but rather on the creation of an entirely new infrastructure, such as for the application areas <u>capital raising</u> and creation of a <u>secondary market</u>, the practical set-up seems to have been established outside of a corporate setting, in the form of an independent start-up or isolated research lab.

Examples in favour of and against this argument exist. Since January 2016, the Australian Stock Exchange (ASX) has been using a private permissioned Blockchain rather than the current Clearing House Electronic Subregister System (CHESS), and it does not conduct its own development but engages the Digital Asset Holdings (DAH) company founded in 2014 (Nikolova, 2019a). Despite recurring implementation delays (Khatri, 2020), the ASX underpinned its commitment to the venture with an increase of its equity stake to a total of $30.9 million in the latest Series-C financing round of the DAH (Nikolova, 2019b). The example of the Canadian Securities Exchange (CSE) disagrees with the argument; it is developing a clearing and settlement platform in-house, based on the Ethereum protocol (CSE, 2020).

To sum up this point, we argue that application areas applying BCt to upgrade and modernise existing processes and systems may be more likely to be implemented out of an internal corporate or corporately funded incubator or research lab structure. Arguably, projects concerning an outright new infrastructure, such as an exchange-like platform, are more likely to arise from start-up ventures.

Performance reporting is the second finding that we evaluated pertaining to the "during execution" process. This concept links to the concepts of assumptions (application area dimension) and education and training before execution (process dimension). There is another link to the involvement of top-level management, which we consider as part of the stakeholder dimension. Now, we focus on noteworthy findings in connection with the performance reporting of the business case. For the bilateral security settlement application area, there were no scheduled reporting deadlines, but progress was directly communicated to senior-level management. This is in line with the given style and strategy of the business case, as described earlier, conducted out of an incubator, a lab or the like, with several projects, transactions and deals belonging to an informal business case: "*we are a reiterating project."* (IV).

In contrast, the business case from the application area of internal organisation, run by a corporate "project team", was "*a project just like any other project, with defined reporting parameters"* (II). The business case concerning capital raising, implemented by a fintech, also followed a stricter reporting regime with weekly meetings. This was most likely due to the close regulatory oversight of the business case – "*As we're regulated, we have our policies and procedures*" (VII) – compared to the nature of a research lab or incubator. Although there appears to be little literature on the subject of

"performance reporting" for incubators, this scarcity may be because, indeed, little reporting tends to take place for incubated firms (Styve & Stubberud, 2018).

Based on our findings, the amount of performance reporting is most lenient for projects executed out of an incubator or research lab environment, whereas it is relatively strict when the project adheres to corporate rules and procedures, and it is most strict when regulatory oversight is directly or indirectly responsible for the conduct of a financial institution. We suggest that this applies especially to a relatively young enterprise without a prior track record seeking to establish an infrastructure, where investors could incur financial losses due to misconduct.

The third point we evaluated pertains to our findings about the **node management** of Blockchains that were implemented in the analysed business cases. A Blockchain is said to be *"private"* or *"public"* ("*closed*" and "*open*", respectively, are often used synonymously) depending on the "reading" rights (i.e. who is allowed to access the data stored on the Blockchain). Moreover, the terms *"permissionless"* or *"permissioned"* refer to the "writing/committing rights", in other words, who is allowed to process transactions in the form of new blocks, and theoretically a subset thereof, and who can update the DL (Garzik, 2015; Hileman & Rauchs, 2017; Pelt, Jansen, Baars, & Overbeek, 2020).

The foundational idea of Blockchain was a "*system based on cryptographic proof instead of trust* […] *without the need for a trusted third party*" (Nakamoto, 2008, p. 1). This type of Blockchain can be described as a "*public permissionless Blockchain*", which can be accessed and written on by anyone (Taskinsoy, 2019). "Writing" refers to the permission to transact via the network and "committing" to the permission to verify the state of the entire chain, in public Blockchains via a consensus mechanism (Hileman & Rauchs, 2017). However, contrary to this still existing, widespread understanding of BCt, access was not strictly public and permissionless in any of the encountered business cases.

Based on the work of Hileman and Rauchs (2017) and a "*taxonomy of Blockchain*" (M. T. Oliveira et al., 2019, p. 4), Table 20 summarises the different **types of Blockchains** we encountered; the business case application areas are assigned according to our understood types of Blockchains in the last column.

Type of Blockchain		Who can read?	Who can write/commit?	Business Case Application Area and other examples
"Private" / "Closed"	Pivate permissionless	Restricted	Unrestricted within restricted group	- Bilateral security settlement - Capital raising - Secondary market - Ripple / EOS / Stellar
	Private permissioned	Restricted	Restricted within restricted group	- Internal organisation - IBM Hyperledger Fabric - R3's Corda Private Networks
"Public" / "Open"	Public permissionless	Unrestricted	Unrestricted	- Bitcoin - Ethereum - Mastercoin - Litecoin
	Public permissioned	Unrestricted	Restricted	- A land registry ledger with restricted writing/committing access, readable by public - Sovrin

Table 20 Types of Blockchain, based on Hileman and Rauchs (2017); M. T. Oliveira et al. (2019)

To clarify, although in some of the business cases, a protocol layer, such as Ethereum was used as the software coding framework, which technically and theoretically reflects a public permissionless Blockchain, the de facto use of BCt, with a pre-approval process in place and the use of smart contracts, reflected private Blockchains.

On the basis of our findings, Table 21 summarises our evaluation of the types of Blockchains we encountered, according to the four application areas shown in the first column. This categorisation of Blockchain types and our finding that all of the encountered Blockchains were *private*, in other words *closed* to all but those "[…] *we preapproved everyone prior to entering our platform"* (VII) are significant for several reasons. First, our findings confirm what we discovered in practitioners' literature: that an "*unpermissioned public network*" (Van Steenis et al., 2016, p. 8) is generally not a viable Blockchain solution for financial institutions, mainly because of "*compliance* – […] *KYC, AML*" (VII).

Business Case Application Area	Type of Blockchain	Who can read?	Who can write/commit?
Capital raising	*"Private permissionless"*	- Investors pre-approved by network operator (restricted)	- All investors pre-approved by network operator (unrestricted)
Secondary market		- Investors pre-approved by network operator (restricted)	- All investors pre-approved by network operator (unrestricted)
Internal organisation	*"Private permissioned"*	- Senior & risk management (read-all) - Departments/ back-office (restricted) - Traders (restricted) - Legal (restricted)	- Senior & risk management (write-all) - Departments/ back-office (restricted) - Traders (restricted) - Legal (restricted)
Bilateral security settlement		- Authorised transaction parties /clients of operator (restricted) - Certain bank departments (restricted) - Regulator (read-all)	- Authorised transaction parties /clients of operator (restricted)

Table 21 Types of private Blockchains encountered in the analysed business cases

Second, certain properties and benefits that are applicable to public types of Blockchains do not apply to private Blockchains, most notably, security characteristics. Public permissionless Blockchains use many publicly criticised, energy-intensive, algorithm-based consensus mechanisms, based on so-called crypto-economics (game theory coupled with incentives), to ensure the immutability of the ledger and honesty amongst transaction parties, whereas private Blockchains tend to avoid this by ensuring legal adherence between transaction parties, off-chain, usually before approval (Corbet, Lucey, Urquhart, & Yarovaya, 2019; Hileman & Rauchs, 2017; Mazzorana-Kremer, 2019).

In all of the analysed business cases, a single network operator restricted access to the Blockchain, pre-approving participants, which rendered them all *private*. Furthermore, following M. T. Oliveira et al. (2019), we believe that *private permissionless* types of Blockchains were applied for two application areas because nodes had the same importance and functions. In the other two application areas, the nodes' access rights differed, suggesting that they were *private permissioned* types of Blockchains.

Third, our findings showed that institutions are following a pragmatic and goal-orientated approach to adopting BCt, implementing the technology in a bespoke and dynamic manner that is most suitable for their specific business needs. One example of this is the building of an immutable audit trail to establish trust amongst transacting parties using decentralised nodes (Kher et al., 2020; Ryan & Donohue, 2017). A reduction of decentralisation and the number of nodes, as we encountered, are most likely to reduce these benefits. Finally, given these practical realities, our argument raises the question about the goals for the implementation of private Blockchains, as we will explore when evaluating the business case goals in Section 6.3 unterhalb.

The third and final finding we evaluated includes two **challenges** with regard to the process during execution, and we highlight them with references to specific application areas. All interview participants described the first challenge pertaining to securing and sustaining **funding**. This can be explained by a number of reasons, depending on the application area in question. For the business cases that we categorised as <u>bilateral security settlement</u>, conducted by banks, the main reason was most likely the exploratory nature of the business cases, without any revenue but with significant cost generation, especially due to the need for expensive expert professionals to build new technology and to navigate the complexities of financial products and their regulation. At the time of the interviews, not only were measurable cost savings unrealised but also potential

savings were difficult to quantify. The business cases consequently did not possess formalised financial calculations. The challenge was augmented by a market environment where banks "*never really managed to get back to pre-crisis profitability"* (I) due to increased regulation and capital requirements since 2009, combined with ongoing low interest rate spreads and rising operating costs (Guo & Liang, 2016; Pinna & Ruttenberg, 2016; Van Steenis et al., 2016).

It is arguably a challenge for any R&D project to obtain and sustain funding; the general sentiment is that the more certain the outlook and pay-off for the research is, the easier it is to obtain funding. Thus, the funding challenge – either internally or externally, depending on the business case under consideration – is most likely not specific to BCt but rather because of the stage in which BCt was at the time of our data collection.

The second challenge relates to establishing **interfaces**. We recognise that this finding relates to challenges of integration and common standards: "*I think the problem with Blockchain-type systems is not the transactions in themselves but the connection of networks*" (II).

It appears logical that the challenge of system integration prevailed most for the application area <u>internal organisation</u>, where BCt was applied within an established IT environment rather than in the building of an entirely new infrastructure. Although one interviewee pointed out that "*the big advantage of the DLT is that you can develop it outside of your existing architecture*" (I), the common industry acknowledgement is that DLT solutions are not implemented in isolation but complement existing ones (Hileman & Rauchs, 2017). The degree of integration requirement ultimately depends on the specific solution that is to be implemented as well as the prevailing environment. Indeed, this point is linked to the dimensions of risks and environment, which are considered subsequently.

For the business cases from the application areas <u>capital raising</u> and <u>secondary market</u>, where entirely new ecosystems were established, interfaces with existing systems were logically less relevant; however, external interoperability with other Blockchains was a critical challenge:

> […] *for us to achieve our goal, make issuance less expensive, making issuance faster, we need these standards in place.* […] *there is a lot of possible technologies emerging. I am a strong proponent of Stick Channels; there are Para-Chains and other means of communications between chains.* (VIII)

We suggest that integration – whether in the form of interfaces with existing internal systems within a given IT infrastructure or between different Blockchains – is likely to be a necessary consideration when implementing a BCt business case. The exact challenges and the extent to which these can pose a risk to the implementation of the entire business case are likely to depend on the specificities of the application, the existing internal IT environment and the existence of external industry standards.

6.2.3 After Execution

It should be pointed out that at the time of our interviews, none of the business cases under consideration had been fully completed; however, parts of the cases or distinct projects had been completed. Therefore, under the sub-heading "after execution", we summarise our findings concerning any business case evaluation that was possible at the time. Of those, we focus our analysis on the **nature of evaluation** (Table 22).

Concepts	Summary of evaluation
After execution	• Nature of evaluation

Table 22 Summary of evaluation: Process – after execution

For all of the business cases under consideration, although the team executing the business case carried out the evaluation, the **nature of the evaluation** differed. Once again, we observed similarities amongst the business cases in the four application areas that we distinguished earlier.

For the bilateral security settlement application area, where the business case we considered was conducted out of a research lab, the evaluation was informal. In contrast, the evaluation that took place for the internal organisation application area followed organisation-specific guidelines, as for any other IT business case of this organisation. For the application areas capital raising and secondary market, the evaluation was a mandatory requirement: "*what's imposed by the regulators is a given*" (VII). Despite these differences in the nature of the evaluation, we identified a similarity, namely that feedback and opinions from outside of the business case team were considered in the evaluation: *"it's a joint effort between the business side and our perspective"* (III).

It appears justifiable to conclude that evaluation occurred for all of the business cases, albeit in different forms and ways. We observed a strong intersection of evaluation and reporting, which we considered as part of the concept "during execution" earlier. Furthermore, we believe that the nature of the evaluation of the business case is dependant on the environment in which the case is implemented.

Where the business cases were subject to regulatory scrutiny, the evaluation was more formal than for cases of an exploratory nature, taking place from within a corporate-sponsored research lab. It was somewhat surprising that a dedicated evaluation team, as was described in the seminal work on IS business case evaluation (Post, 1992), was not formed for any of the business cases. This is likely due to the challenges we evaluated in the previous section, During Execution, specifically the topic concerning funding and scarce resources, and unless evaluation was necessary, this part of the business case process took place informally, with as little as possible additional effort required.

6.3 Goals

Maes et al. (2014) defined business case objectives as "*any particular reason why a business case should be developed*" (Maes et al., 2014, p. 52), and they clustered respective literature findings in a dimension called "goals" (Maes et al., 2014). In the inductive analysis of our results, we found 20 categories that merged into 10 concepts or, in other words, motivations, drivers and objectives for why BCt was chosen in the considered business cases related to security settlement. We now turn to evaluating these findings, using the term "goal(s)" to refer to the aforementioned list of terms.

Indeed, the term "goal", is commonly used in both academia and practice to connote a business strategy (Osterwalder, 2004), governance requirements (Jordan & Silcock, 2005, pp. 76-77) and/or corporate profit maximisation (Hui, Ka-Meng, & Ching, 2017), amongst other things. It appears to be the most suitable term for the underlying reasons for the decision to implement a BCt business case. We cross-referenced the 10 goals with the four application areas of BCt, which we established in the first part of our evaluation, as indicated by an "x" in Table 23. Based on the results of our qualitative interviews, these cross-sections indicate which business case goals appeared to be most significant for the four business case application areas.

Application Area Business Case Goals	Bilateral Sec. Settlement	Capital Raising	Secondary Market	Internal Organisation
1. Cost reduction	x	x	x	x
2. Internal competences	x	x	x	x
3. Market monitoring	x			x
4. Risk management and reduction	x			x
5. Political and regulatory reasons	x	x	x	x
6. Increasing transparency		x		x
7. Market efficiency and liquidity		x	x	
8. Business opportunity	x	x	x	
9. Settlement speed	x	x	x	x
10. Competitiveness	x			x

Table 23 Business case goals cross-referenced with application areas

For goals that encapsulate several findings, we include a table to visualise the underlying findings (see, for example, Table 24, next page). We evaluate these 10 goals in the following Sections 6.3.1–6.3.10, starting with a brief recap of our findings whilst identifying linkages to other goals and dimensions. Thereafter, we specify how each goal applied to business cases from each of the four application areas. Finally, we evaluate our findings in light of available literature seeking to understand why the goal was a driving force in the Blockchain business cases.

6.3.1 Cost Reduction

We subsumed four of our findings under the goal “cost reduction” as shown in Table 24 and argue that cost reduction was a goal for all of the considered business cases. We assessed whether some of the four findings applied only to specific application areas that we identified earlier, but dismissed such a subdivision because, first, cost reduction was a strong goal in all business cases, and second, multiple findings of cost reduction applied in different ways. For business cases of the bilateral security settlement application area, the focus seemed to be predominantly on increasing operational efficiency by reducing the number of process steps that were required internally to settle a trade. We considered this point as part of the concept of advantages (application area dimension) in Section 6.1, page 103.

Application Area Business Case Goal: *Cost reduction*	Bilateral Sec. Settlement	Capital Raising	Secondary Market	Internal Organisation
#1 Reducing cost of security settlement #2 Reducing cost of capital raising #3 Reducing cost by decreasing the number of intermediaries #4 Increasing operational efficiency	x	x	x	x

Table 24 Business case goal of cost reduction cross-referenced with application areas

For the business cases from the capital raising and secondary market application areas, "[…] *you have one main reason, which is making issuance cheaper*" (VIII). A less costly capital raising was to be accomplished by two levers linking this point with other goals: First, market efficiencies were to be achieved through a reduction in the number of involved intermediaries. Second, the aim was to standardise and streamline the issuance process, which connects to the goal of settlement speed. To this end, smart contracts coded in the Blockchain, coupled with other technologies, were used to automate processes and reduce otherwise significant legal fees to a small royalty for the documents. This ultimately allowed for an almost instantaneous, fully compliant issuance, with the prospect of a business opportunity. For business cases regarding internal organisation, we infer that cost reductions were sought via an increase in operational efficiency, especially with regard to risk management, which is considered as a separate goal in Section 6.3.4.

Excerpt 3 reflects the way in which interviewees answered the question regarding cost reduction, both directly and indirectly, as indicated in the first three and last three quotations, respectively. In several cases, cost reduction was "[…] *probably the number one. I would say cost is the key driver"* (I).

What do you see as being the main business drivers, the motivators of the business case / behind this technology?

"Opportunity to reduce the cost base of the activity" (I)

"It's cost" (II)

"Oh – cost!" (VI)

"[…] the objective is to bring efficiency to the trading floor" (V)

> *"[...] looking at the secondary trading, reducing the need for intermediaries [...]" (VII)*
>
> *"From the primary perspective, you have one main reason, which is making issuance cheaper" (VIII)*

Excerpt 3 Interview excerpts on business case goals

We observed two main reasons for the importance of cost reduction to the business case goal. First, according to industry research, there is the magnitude of the potential annual savings of USD 11 to 12 billion on operational expenditures, fees and charges for the clearing and settlement of cash securities (Priem, 2020; Schneider et al., 2016), corresponding to the bilateral security settlement application area.

Cost potentials for other areas, such as banks' internal infrastructure, offer even greater potentials, with estimated savings of $15–20 billion annually (Santander et al., 2015), corresponding to the internal organisation application area. Assuming that these industry potentials account for the necessary depreciation of initial investments and ongoing maintenance cost of BCt systems, these savings translate into attractive profitability gains.

Second, the ability to reduce cost appears to be a means to stay in business, given decreasing profitability in the banking industry, which we evaluated earlier as part of the challenges in the "during execution" concept (process dimension). Competitive pressures exist, as we will evaluate, especially by young fintechs with a lower cost base, focused applications, and a keenness to obtain market share such that: "*the only way to stay significant here, is to act on cost"* (I).

Our findings confirm the general agreement that BCt has the potential to significantly reduce costs. Examples include a 30% cost potential in banks' back-office automation of OTC derivatives (Priem, 2020) as well as substantial cost savings thanks to unnecessary initial and mark-to-market collateral posting and error reductions in manual processes (CSE, 2020).

It is interesting to recognise that cost reductions were an important goal in all of the analysed business cases. At the same time, in all but one case, classical project financing calculations were not applied. This apparent incongruence is further considered in our discussion.

6.3.2 Internal Competences

This goal to "*do it ourselves"* (II) ties into our evaluation of the business case design as part of the "before execution" concept (process dimension), where we found that for all of the business cases considered, the design was geared towards promoting internal competencies and fostering education and training. Furthermore, we suggest that the development of internal competences is closely linked to the goals of both revenue opportunities and competitiveness "*to enable BANK to leverage on this new technology without depending on external support"* (IV). Indeed, our reasoning for the emphasis on establishing an own knowledge base and internal expertise relates to these two goals, coupled with the still early stage of the BCt.

First, it appears to be rational to establish in-house competences to be able to flexibly pursue an exploratory strategy with the potential of finding relevant applications, either to generate new revenue streams or to improve existing services. In line with this, building necessary organisational competences to reconsider existing business models was part of a research question about the response of incumbents to BCt (Beck & Müller-Bloch, 2017). Moreover, we suggest that an internal team of experts is more likely to secure competitive advantages over both competitors and new market entrants.

Finally, the development of own internal competences may simply be explained as a solution to the challenge of finding and funding specialised human capital in this field: "*You are looking for highly skilled, specific type of knowledge that very seldomly already exists in the organisation* […]" (I). This is connected to the challenge considered in the concept "during execution" (process dimension) and confirmed by references to the scarcity of Blockchain competences (Beck & Müller-Bloch, 2017) as well as the need to add BCt skills to given curricula (Nomura, 2016). Part of the goal of developing internal competences is arguably to educate internal staff about the basics of BCt and the theoretical possibilities such that a fertile culture is created on a broad basis, motivating people across different parts of the organisation to start considering possible ways to implement BCt (Holotiuk & Moormann, 2018).

6.3.3 Market Monitoring

Linked to the evaluation of business case design as part of the "before execution" concept (process dimension), we found that some financial institutions were pursuing a predominantly exploratory strategy in their business cases: *"They are investing some money in Blockchain because they don't know whether the impact is going to be in two years, in five years or in 10 years"* (I). Most pertinently, we found that market monitoring

was a goal for the business cases we had grouped into the bilateral security settlement and internal organisation application areas. This appears logical, since the business cases that we grouped in these application areas were conducted from within so-called incumbent financial institutions, which also engaged BCt to remain competitive. Indeed, we recognise a close connection between this goal and competitiveness, given that "*from an executive level perspective, I think they see the need for it because* […] *the business will change with BANK or without BANK*" (IV).

In fact, we argue that the goal to stay competitive is a reason for the objective of acquiring market intelligence. Given the relatively immature stage of BCt with several potentially untapped use cases that could arise in the marketplace, this goal of market monitoring appears to make sense. Nevertheless, there appear to be few direct references to such "market monitoring" business motivations in the analysed literature. Although there are descriptions of POCs (Lord et al., 2017; Mills et al., 2016), which are arguably a form of market monitoring through testing and structured monitoring, they emanate from the public sector, such as central banks (Hileman & Rauchs, 2017) and regulators (FSB, 2018), rather than private corporations.

6.3.4 Risk Management and Reduction

To start, we highlight the existence of various types of risk, not only in relation to IT, which is considered in a separate subsequent dimension, but also with regard to finance. Furthermore, we base our evaluation on the understanding that risk reporting and management is part of or closely related to the settlement process (Loader, 2019, p. 21; Swartz, 2017). Four of our 20 goal categories (Table 8, page 70) conceptually relate to this goal, as shown in Table 25.

Application Area Business Case Goal: *Risk Management and Reduction*	Bilateral Sec. Settlement	Capital Raising	Secondary Market	Internal Organisation
#7 Optimising risk management #8 Creating an immutable audit trail #9 Reducing operational risk #10 Reducing counterparty risk	x			x

Table 25 Business case goal of risk management & reduction cross-referenced with application areas

We interpret this goal to apply especially to the business cases we grouped under the application areas bilateral security settlement and internal organisation. Here, we found that managing, controlling and thereby reducing counterparty risk were central goals of the business case. It was implemented using a DL to efficiently aggregate risk across the entire organisation and provide a real-time risk management tool, whereas previously, it was only possible to "*see what counterparty risk there is in a debit or credit type. You can't see your risk over a network"* (II). Although in the application areas capital raising and secondary market, efficient means of risk management were also important, we did not identify risk management and reduction as an explicit goal here.

We note a strong link between risk management and risk reduction on the one hand and the goal of reducing cost on the other, and we argue that there are two potential sources of cost reductions. The first source of cost reduction relates to an optimisation of the risk management processes and is also based on the importance of the BCt feature of an immutable audit trail:

> *So the traders would have their file. The management would have their file. The accountants would have their file. And everybody would be running around trying to understand what had happened. […] They were spending hundreds of thousands of pounds on contract accountants to manage this whole plethora of instruments they had on spreadsheets, and they wanted to put it in a more manageable form.* (II)

The second source of cost reduction relates to the reduction of counterparty risk: "*The way they find out what the value of risk is at the end of a month, they set up an Excel spreadsheet. And two days later, it comes up with an answer, of this derivative losing a billion*" (II).

The risk for a dealer to perform such VAR calculations for non-exchange-traded derivative products only infrequently, as described above, is that the counterparty is unable to meet the infrequent and potentially large margin call, and a loss may consequently be incurred. Given that under general accounting practices, such as IFRS 9; 5.7.1 (IFRS, 2019), such a loss on a financial asset must be recognised as a loss, cost and BCt can be seen as a system to reduce or even prevent such costs from occurring.

Reducing counterparty risk is one of the core value drivers of DLT (Dalal et al., 2017; Mainelli & Milne, 2016). This feature is thus existent in arguably every BCt business case related to settlement, including those from the bilateral security settlement application area. However, in comparison to the business case from internal organisation, here we

would argue that it was a welcome effect but not necessarily the main business case goal: "[…] *next to operational cost reduction, risk reduction is one topic for us, especially in the securities markets*" (IV).

Cross-referencing this with existing market understanding (Générale, 2017), we can confirm that a successful POC demonstrated the occurrence of a trade with neither CCP nor CSD involved and, given existing risk-monitoring systems, virtually no risk: "[…] *of course there was a risk, for some seconds, but the system can't track the seconds, so the system said there is no risk. Because it was intraday settlement*" (III). This example highlights an interesting point: that DLT does not eliminate counterparty risk, and rather than removing risk in total, it merely reduces it. Other risks, such as operational IT risks and risks from security threats (OECD, 2020) remain in relation to the dimension on risks.

6.3.5 Political and Regulatory Reasons

Table 26 indicates that political and regulatory business case goals were found, on the one hand, in reference to regulatory reporting (as also seen in the goal, Section 6.3.6, to increase transparency) and, on the other hand, with regard to setting political standards, relating to regulatory risk, which will also be considered in the dimension on risks:

> *If the regulator comes along and changes something, well that's just life […]. That's why we wanted to grow as quickly as possibly, […] so that we can have more of a say, we can help steer the conversation and be part of it.* (IX)

Based on our qualitative interview findings, we believe that this goal was important for business cases of all four application areas, but not with the same background.

Application Area Business Case Goal: *Political and Regulatory Reasons*	Bilateral Sec. Settlement	Capital Raising	Secondary Market	Internal Organisation
#11 Setting standards	x	x	x	
#12 Regulatory reporting				x

Table 26 Business case goal of political & regulatory reasons cross-referenced with application areas

Our category "setting standards" can be related to the goal of creating the necessary legal framework for BCt-based settlement business models to be legally feasible altogether, given that in many jurisdictions, there is still a "*severe lack of legal certainty in this* […] *Blockchain sector*" (X), and one must "*raise awareness at the political part that if you don't change some things, then Germany as a market for securities will have a problem*" (III). This links to our evaluation on the challenge to educate the regulator

(process dimension, page 108) and the concept of regulatory risks (risk dimension, page 140).

However, we also note another motivation for setting standards, related to the idea of firms lobbying regulators to impact regulatory changes to their advantage – a well-known and well-researched phenomenon (Kerr, Lincoln, & Mishra, 2014; Kim, 2008). The mechanism of supplying governmental agencies with consultancy and advisory services to implicitly take influence is a further, seemingly less academically scrutinised motivation (Anastasiadis, Moon, & Humphreys, 2018; Coen & Richardson, 2009, p. 53). Lobbying work has also been related to new technology investments (Weigelt & Shittu, 2016).

In the business case from the application area internal organisation, regulatory pressures to improve risk management systems were a major goal and possibly the trigger for the business case: *"Because they were continuously getting regulatory static on the ability to manage their risk, that probably was the precursor that, 'we'll look at alternative ways of doing this', and that's what motivated them in the first place"* (II).

In the business cases from the other three application areas, regulatory reporting was a factor but not the main goal. Whereas BCt solutions "*satisfying regulatory requirements*" represent a popular subject matter (BIS, 2017; Van Steenis et al., 2016), directly related references to a business case goal to meet regulatory requirements appear to be scarce. The regulator was to obtain a node to be able to monitor the market activity efficiently, as we will further evaluate in the goal of market efficiency and liquidity.

6.3.6 Increasing Transparency

The goal to increase transparency links to three other goals of the business cases in three different application areas. Therefore, for this goal we used a table to show the linkages (Table 27, overleaf). In one way, increasing transparency relates to the goal of risk management and reduction with the development of a system for "*real-time risk management"* (II), which we observed in the business case of the internal organisation application area.

Application Area Other goals related to increasing transparency	Bilateral Sec. Settlement	Capital Raising	Secondary Market	Internal Organisation
4. Risk management and reduction				x
5. Political and regulatory motives	x			
7. Market efficiency and liquidity		x		

Table 27 Links between the goal of increasing transparency and other goals

Another aspect relates to the goal of market efficiency and liquidity, where greater transparency was sought in relation to capital markets, primarily for non-exchange-traded assets, which we identified in relation to the capital raising application area. Finally, increasing transparency was found to be a goal in relation to efficient regulatory reporting, for example in the form of a "*regulatory node that has read-all access to all transactions"* (III). This goal ties into the goal of political and regulatory motives, which we recognised in relation to the bilateral security settlement application area.

Indeed, increased transparency is one of the most frequently hailed advantages of BCt, along with security, risk reduction – immutability and efficiency – and cost savings (BIS, 2017; Dalal et al., 2017; Labazova et al., 2019; Mainelli & Milne, 2016; Schneider et al., 2016), not only for the clearing and settlement of securities (Priem, 2020) but also beyond use cases in finance, ranging from healthcare to real estate (Laroiya et al., 2020). However, at least some of these citations seem to refer to public Blockchains, which in practice are an exception, as we considered in the types of Blockchains in the concept "during execution" (process dimension).

We argue that increased transparency is not necessarily given in private Blockchain applications but is indeed inherently available as part of the technology and is specifically identifiable in different situations, highlighting the appeal of this goal. In relation to risk management, counterparties would have pre-trade transparency, effectively eliminating the need for CCPs, which links this goal to yet another one, namely cost reduction. With regard to capital market transparency, Nasdaq Linq is a prime example of how equity issuing companies benefit from BCt-based, transparently accessible equity ownership records, without having to manually track and transfer ownership rights (OECD, 2020). Finally, with respect to regulatory reporting, increased transparency was found to be an attractive benefit, not necessarily for a regulatory body but rather for its stakeholders, such as a government supervising a central bank (Hileman & Rauchs, 2017).

6.3.7 Market Efficiency and Liquidity

"*To make capital markets more efficient* […]" (VII) was designated as a business case goal, as was liquidity, given that "[…] *for all others that are not big enough for the existing stock exchanges and for liquidity, for those, tokenisation opens up the access to capital markets*" (X). We see "market efficiency" closely linked to the goal of reducing cost because more efficient market structures allow for lower transaction costs (BCG, 2012). Moreover, we see "liquidity" closely linked to the goal of increasing transparency because we argue that a prerequisite for liquidity is a transparently available record of ownership. We also consider that our finding about BCt allowing for greater transaction certainty is linked to political and regulatory reasons.

Although greater efficiency and liquidity were a welcome effect in all of the business cases, market efficiency and liquidity were found to be specific goals in the business cases of the application areas capital raising and secondary market. For, capital raising, a lack of transparency and inefficiency in a specific part of the capital market were identified as business opportunities to use BCt-based tokenisation for companies to raise capital: "*the current way of raising money for small companies is either too expensive, very broken or very poor returns for investors*" (VI). Different to, for example, exchange-traded assets, the equity of SMEs is predominantly privately placed, rarely traded and known mostly only to those parties involved.

For the business cases of the secondary market application area, the same arguments as for those of the capital raising application area apply, augmented with the possibility of reducing the number of intermediaries to "*one single settlements layer*" (VIII). Additionally, we interpret our findings for the two points to be interconnected to each other, with higher efficiency facilitating greater capital market liquidity (Schneider et al., 2016) because lower transaction costs are likely to attract both investors and those seeking to raise capital.

From a regulatory viewpoint, as mentioned for the goal of political and regulatory reasons, transaction certainty could be improved with the regulator following a "*transactional regulation*" (III), obtaining access to the Blockchain and approving trades instantaneously based on algorithms as part of the trading process. Only a few transactions in disagreement with these automated checks would be held back or subjected to later approval, rather than all transactions, as is currently the case. However, it appears that some regulators are still working on implementing such a paradigm shift:

> *We already implemented a regulatory node that has read-all access to all transactions; from a legal perspective right now, this is sufficient for us to report information to the ECB* [European Central Bank]*. However, this would mean that the 70–80 people, if that works for all of our transactions at* [BANK]*, need to be employed by ECB. Because they get the same information basis, but what they actually want is summarised information for reporting. They don't want to cope with all the* […] *data. They want to have reports; that's why we have these reporting guys.* (III)

Efficiency and liquidity, sometimes in dependency of each other, are some of the most repeatedly named advantages of BCt (Manning et al., 2016; OECD, 2020; Paech, 2016; Schneider et al., 2016). We reason that their importance as a business case goal are deeply intertwined with the goals of cost reduction and business opportunity.

As part of the concept description of the use of BCt (application area dimension), we considered certain assets for which transaction volume is too low to support the transaction costs incurred, for example, by advisers and intermediaries existent in given primary issuance processes. This is in accordance with literature (Crosby et al., 2016; OECD, 2020); therefore, we suggest that for such assets, efficiency potentials offered by BCt are possible to reduce costs such that significantly smaller primary issuances to take place whilst promising an economically attractive business opportunity.

6.3.8 Business Opportunity

Based on our evaluation of the market efficiency and liquidity business case goal, we conclude that potential business opportunities were directly or indirectly based on the use of BCt to reduce cost, compared to current market practices. Directly, BCt, in combination with other technologies, was used for capital raising to establish efficient, scalable and hence cost-effective processes: *"we could see the revenue generation and profit generation from our factory approach"* (VI). Less directly, in business cases that we had grouped under the bilateral security settlement application area, following an exploratory business case strategy, the search for viable BCt-based business opportunities and better client services offered a chance to differentiate otherwise highly homogenous trading and settlement services from competitors. This creates a direct link not only to the goal of market monitoring and competitiveness but also to settlement speed:

> *If technology is there, right, and say all the market works of T+3 and basically, in the back of their mind, they are kind of refraining from quicker settlement, if few institutions go for an aggressive T+0, then me as a client, as a brokerage client, I can either go to Morgan Stanley and still be held at T+3, or I can go to Goldman and get T+0. Guess what? And the market will move inevitably just because of*

> *course a more advance group decided to be client-friendly and offer T+0. I think it's inevitable – if technology allows for this efficiency, ultimately it's going to be brought to the market.* (V)

Based on these findings, we argue that business opportunity is a strong goal in almost all Blockchain business cases. In cases where it was an explicit, outspoken, direct goal, it appeared to be closely related to other goals. Therefore, the question of why business opportunity was a goal in the analysed business cases must be answered in reference to various other aspects, as above, and it arguably ultimately relates to the underlying goal of corporate profit maximisation. Our findings that BCt not only offers a wide range of business opportunities in terms of improving existing processes but is also actively sought after as a new business opportunity as such, regardless of the age and maturity of the organisation (Beck & Müller-Bloch, 2017) and especially by first movers (Lord et al., 2017), corresponds to and confirms common consensus.

6.3.9 Settlement Speed

We touched on the goal of settlement speed earlier and identified several connections to other goals:

> *If you have traditional clearing, with two or three days clearing time, and you do this instantly, so you don't have two or three days of the money lying around, that's actually a risk reduction and of course also a reduction of bound capital and thereby its capital cost reduction.* (III)

In comparison to settlement cycles of several days, it takes, for example, approximately ten minutes for a new block to be written on the Bitcoin Blockchain and 13 seconds on the Ethereum Blockchain (Economist, 2021), theoretically fulfilling the processes of execution, clearing and settlement. Such an offer of faster settlement speed alongside a reduction in the cost of capital for clients should increase competitiveness, which in turn creates a business opportunity. We identified this goal, with slight variations, in business cases from all application areas. Furthermore, we argue that increased settlement speed relies largely on the possibility of disintermediating intermediaries such as CCPs and CSDs (illustrated in Figure 8, page 24), which in turn relies on an expectation of and trust in the immutability of records, based on BCt, which ultimately allows for the possibility to reduce cost.

Manning et al. (2016) support this argument. Greater settlement speed touches on several aspects and promises vast potentials but is subject to widespread debate (Manning et al., 2016). One interesting question in this regard is whether, even if technologically possible, market participants have an interest in moving to the often-

mentioned near "*real-time clearing and settlement*" (OECD, 2020). In current structures, where for equities, for example, settlement commonly takes place *T*+2, not infrequently, transaction parties use that time to make available the committed cash or security (Mainelli & Milne, 2016).

6.3.10 Competitiveness

Synthesising two of our findings, namely "public relations" and "maintaining competitiveness" – "*being in the market, making sure that you don't lag behind […]"* (I) – we see linkages to a number of other goals, especially market monitoring, the development of internal competences, the search for new business opportunities and cost reduction. One plausible way of describing the combination of these goals is the term "opportunity cost", as explained in Excerpt 4.

As of today, please describe the business case.

> *Very easy. I think two points: First point, […] there's a cost saving case. But that wasn't the biggest rationale behind it, as far as I guess, because what we actually looked at were opportunity costs; […] we pretty much know that there will be market development with or without us. If the technology is coming, it's not depending on whether our BANK likes it. So it's coming either way. So the only question you could ask yourself is, do you want to participate or not? And so we could argue participating is better than not. (III)*

Excerpt 4 Interview excerpt on business case goals

The "opportunity cost" referred to in Excerpt 4 can be interpreted as a fear of missing out (FOMO): "*because they cannot lag behind the piers*" (I). "*C-Suite FOMO*" on "*the next big thing*" has been mentioned (Swartz, 2017, p. 87) and applied as a "*Blockchain adoption driver*" in relation to buying Bitcoin and other cryptocurrencies (Koens & Poll, 2018, p. 4).

It appears justifiable to argue that such FOMO links to the goal of developing own competences, thereby completing a virtuous circle with higher competitiveness: "*The objectives were simply cost driven but then became related to capacity. They then understood the fact that they now have the capacity to do this, and that has become a very useful competitive advantage* […]*"* (II).

Furthermore, the goal of competitiveness most likely explains our finding of the objective that, "*if you come up with something, market it because you want to show that you're actually investing in innovation"* (I).

We conclude that the goal of competitiveness is closely related to a number of business case goals with a more common reference to “higher efficiency”, which we considered as part of a number of other goals. We ultimately saw that goals of cost reduction and the initiation of new business opportunities culminated in fundamental corporate goals of profit maximisation and survival.

6.4 Stakeholders

“Stakeholders” commonly refer to people and groups of people, such as shareholders and clients, leaders and managers, employees, suppliers and end users (Dyllick & Hockerts, 2002; Hwang, 2005; Post, 1992). More specifically, skill-related categorisations such as software developers, researchers and legal professionals are common (Pelt et al., 2020). In recent literature, and possibly subject related, there is also a trend to include fewer human entities such as organisations, custodians, the media, research labs and universities (Kiarie, Henry, & Rong, 2018; OECD, 2020; Pelt et al., 2020). Based on these descriptions, we define business case stakeholders as people and organisations that can contribute to the success of a business case and are impacted by its success (Maes et al., 2014). We distinguished between “internal” and “external” stakeholders based on our coding process (Jordan & Silcock, 2005, p. 186; Pelt et al., 2020; Sachs, 2011, p. 40). Following this differentiation, we focus on the evaluation of a selection of our findings, as listed in Table 28, cross-referenced with existing literature as well as other parts of our evaluation.

Concepts	Summary of evaluation
Internal	• Internal core team supported by professionals from their organisation • Diverse competences from various business lines / departments, for example - Corporate strategy (business analysts and research) - Back-office (clearing, accounting, legal) - Markets (trading) - Technology (software development) • Senior-level management
External	• Few external consultants • Legal advisers

Table 28 Summary of evaluation: Stakeholders

6.4.1 Internal Stakeholders

In line with our evaluation of the business case goal to develop internal competences, we found a strong emphasis on internal stakeholders. Interview participants explained a strategy and motivation to establish an internal organisation project, with a relatively

small, dedicated, ring-fenced **internal core team**, working group or incubator with five to 10 professionals per project. This corresponds to our evaluation as part of the process dimension, where we recognised a strong tendency towards an internal business case design. Some of the team members had been with the organisation for a long time, were highly experienced and were familiar with the organisational culture:

> *It was a group of people who'd all been with the bank for five years – at least – some of them had been with the bank for 30 years.* […] *Everybody knew how they did things: Writing the code, the integration, et cetera. And they just went on and did it. (II)*

There appear to be fewer references in the literature to such an internal focus on IT-related competences, skills, knowledge or know-how. More generally, the emphasis on internal competences is known from the Value Shop configuration (Fjeldstad & Snow, 2018), and Arunthari (2005) pointed out that experienced internal IT staff are necessary for the implementation of ERP systems.

In different ways and to varying degrees, we recognised the **diversity of competences** either within the core project team – "*We do have guys from our IT department, from business analyst, to and this is the most important thing, developers*" (IV) – or in a set-up where the project team was able to draw on diverse expertise and skills from operational units of the entire organisation: "*The accountant provided the back office; the process guy provided the trading; the other eight, they provided a whole wealth of skills across basically the processes of the bank, as well as the information technology"* (II). This confirms a finding on the benefits of multi-functional teams for the organisational adoption of BCt (Holotiuk & Moormann, 2018). We propose that the need for such diverse functional skills and experiences is inherent in the BCt, where the development of a solution requires diverse skills, as one interviewee explained:

> […] *what we had in common was that we were able to have visions – we could imagine something that wasn't here at that point,* […] *but there have been IT experts, entrepreneurs from the Blockchain sector, lawyers, researchers from the university, financial market experts and people from the government authorities.* (X)

The support of **senior-level management**, with their direct involvement in the progress and development of the business case, seemed to play an important role:

> *The most important thing here is personal involvement. So when I look into [C-Level managers' names] willingness to drive the topic and one of them is still co-lead of this lab, willing to give his employees the freedom to build up such a thing – this is very important.* (IV)

The value and importance of top-level support for the successful implementation and adoption of not only new technology (Kiarie et al., 2018; Lin & Lee, 2005) such as ERP systems (Basoglu et al., 2007) but also arguably any corporate IT project (Jordan & Silcock, 2005, p. 82; Sachs, 2011, p. 201) is well researched and known.

6.4.2 External Stakeholders

In addition to the earlier evaluated rationale to establish own internal competences, another reason for **few external consultants** may be our finding, as stated explicitly in one interview, that financial institutions had "*[…] paid many hundreds of thousands of pounds to the consultants who promised everything, and they delivered pieces of paper. They did not deliver workable solutions"* (II). We merely found references of the positioning of major consultancies and auditors as experts on BCt (Holotiuk et al., 2017).

We were unable to find any detailed descriptions of the involvement of consultancies in BCt project developments or implementations. This, in combination with the insights we gained from our interview with an expert in digital innovations in financial institutions, from one of the major strategy consultancies, leads us to argue that the space is dominated by internal efforts from within financial institutions or start-up ventures.

Concerning the involvement of law firms, we found intensive involvement of **legal advisories**, with a strong cooperative involvement between clients and advisers. This confirms our earlier interpretation based on the novelty of the subject matter and allows for a suggestion that the amount of required legal advice is likely to fade with increasing technological maturity:

> *Hundreds of hours dealing with lawyers and the regulator – writing documents, explaining those documents, stepping through processes. Showing them the platforms,* […] *explaining how our KYC works, how our identity works, how we ensure the authenticity and there is no money laundering going on, no scamming going on* […] *All of this process took* […] *three major law firms in the UK – international law firms.* (VI)

We consider the financial services regulator to be an external stakeholder. However, for two reasons, we discuss the involvement of the financial regulator as part of the environment dimension, Section 6.6 unterhalb. First, in light of our earlier definition of stakeholders, a regulatory body appears to be a highly abstract grouping of people. Second, we consider the impact of the regulator on the business case environment to be significant.

6.5 Risks

In this section, we evaluate the concepts that emerged in our coding process, pertaining to risks, as summarised in Table 29. An IT risk can be defined as an adverse IT-related event with damaging business consequences (Jordan & Silcock, 2005, p. 7). From these, we consider project risk and strategic risk to be predominantly IT-related risks, given the complexity of IT projects. We see new technology and regulatory risk related to the novelty of BCt and interoperability risk and responsibility risk as being inherent in the nature of BCt and its particular use within security settlement. Indeed, a plethora of financial market-related risks exist in this area, commonly grouped into market, credit and operational risks (Loader, 2019, p. 200). The merely peripheral consideration of these risks in our results may be related to the potential of BCt to reduce some of these traditional risks or other risk aspects that were more relevant or present in the minds of our interviewees.

Concept	Summary of evaluation
Project risk	• Project uncertainty • Risk of the investment failing • Vested interests
New technology risk	• Lack of experience • Lower reliability/stability than existing technology • Provision of technology-specific continuous support
Interoperability risk	• Lack of interoperability between different BCts • No common industry standards • Legacy systems
Responsibility risk	• Custody / private key management • Single point of failure (SPF)
Regulatory risk	• Regulatory uncertainty • Risk of legislative changes
Strategic risk	• Competitor risk • Public relations • Reputational risk • Path dependency risk

Table 29 Summary of evaluation: Risks

We focus on risks that we found in the Blockchain business cases. In the following sections, we evaluate the concepts that emerged from our inductive approach, highlight their linkages with other risks and dimensions and reference the business cases from the four application areas in light of existing literature.

6.5.1 Project Risk

The concept of project risk that we found refers to the risk of a designated project failing for various reasons (Jordan & Silcock, 2005). We see a strong connection between

project risk, essentially *"*[…] *that the money is gone"* (IV), and the uncertainty resulting from the early stage of BCt. **Project uncertainty** concerning either the subject matter or the technological implementation was found in different forms in business cases related to all of the four application areas. A relatively high level of project uncertainty is reflected by the exploratory business case designs which we considered earlier: "*A lot of risk in the technological development comes from the uncertainty on what you are building"* (VIII). This risk is likely to be one reason for recognised expectations that many BCt projects will fail (Crosby et al., 2016).

Furthermore, we see a connection to **vested interests**, which were found to impede operational optimisations in securities' clearing and settlement (Mainelli & Milne, 2016). There exist various references to the vested interests of market incumbents, such as custodians and banks (Van Steenis et al., 2016), and this appears to have amplified the uncertainty-related project risk: "*there's a lot of parties that have a lot of vested interests for things in different ways like being visible, not being visible, hiding things, keeping their clients to themselves* […]" (IX).

These interests can shape the industry (Paech, 2016) and may have an effect where it is more attractive for certain market participants to maintain profits and extract rents from the status quo than to engage in the uncertainties resulting from the novelty of the technology, with uncertain pay-offs and or outlooks about the achievement of business case goals, such as cost reductions. This can act as a deceleration in the pace of change (DTCC, 2016) or even a barrier to the adoption of BCt-based solutions (OECD, 2020).

6.5.2 New Technology Risk

Our concept of risk regarding the novelty of the technology emanated from a number of risk-related categories, such as **lower technological reliability**: "*your new technology, whilst claiming efficiency, may be far more riskier"* (V). We found that this risk was most likely to occur for business cases of the application areas <u>bilateral security settlement</u> and <u>internal organisation</u> because in these cases, the aim was to replace existing systems that are currently operating. For the business case from the application areas <u>capital raising</u> and <u>secondary market</u>, a new system was being established such that the risk may not have been as pertinent.

We see a relationship with the risk category of IT service continuity, which refers to the risk that operational processes are interrupted by an IT failure (Jordan & Silcock, 2005, p. 118). This in turn links to categories of our interoperability argument, which is

considered next, given that a new technology requires new interfaces and may not be compatible with given internal and external legacy systems and infrastructure.

Indeed, risks in regard to technology are well known and categorised in detail, for example in a seemingly comprehensive summary of risks (Loader, 2019, p. 227). Interestingly, this summary does not include "new technology" or the like. References to such risks do, however, exist indirectly, given an unfamiliarity with the technology (Sarkis & Liles, 1995) or market infrastructure (Priem, 2020). Furthermore, **continuous support** appears to be closely related to reliability issues of new systems as a technology risk – "*lack of support for systems*" – in the above-mentioned list (Loader, 2019, p. 227): "*Continuing support was the biggest risk* […]*, which is a problem at three o'clock in the morning when the markets open in two hours.*" (II).

In relation to BCt, we did not find any mention of such risk, which may be because there are few operating BCt-based settlement systems, and those in operation are primarily used for internal organisational purposes and subjected to non-disclosure policies.

6.5.3 Interoperability Risk

We see linkages between the concepts of **lacking interoperability** and **common industry standards** that emerged from our findings and the risk classification "applications" by Jordan and Silcock (2005, p. 49). In fact, within this wide-ranging risk class, the authors explicitly described "*integration and interoperability*" in relation to the risk of the weakest link in a system, reliant not only on shared data but also on infrastructure such as authentication services, which increase the efforts and risk of monitoring and maintenance (Jordan & Silcock, 2005, p. 191).

Legacy systems also emerged as a category of interoperability, as evidenced in the following citation: *"Large-scale back testing was done, and then the system crashed on the very first day it was implemented because one of the links didn't fit in with their own internal systems"* (II). Associated to infrastructure, the risk is that infrastructure "frails" into a so-called legacy system, with increasing cost and risk associated with supporting and replacing it. Interoperability issues occur within an organisation when either changes are made to the existing system or, as in the case of BCt, new systems are not implemented because of the risk that **legacy systems** will be unable to connect to them (Jordan & Silcock, 2005, pp. 191-192).

Logically, this risk applied more pertinently to business cases where the aim was to replace or advance given IT systems with a BCt-based system. In business cases in the application areas of both bilateral security settlement and internal organisation, the risk to connect to legacy systems appears to have been augmented by the relatively outdated systems in existence, where "*infrastructure is basically built upon computer systems with probably an average age of 35 years and settlement concepts which come from the 19th century"* (II).

Furthermore, there appears to be an interesting link to the concept of project uncertainty, which we evaluated earlier as part of project risk. Given a high level of uncertainty concerning BCt, there could be a greater need for DLT solutions to integrate into existing IT landscapes:

> *You actually don't replace the old solution, which is very unusual, because usually when you have a change activity, you actually replace the activity itself.* […] *In Blockchain, you actually are creating a solution or an initiative that runs in parallel with the business as usual. Because you're uncertain about the outcome, it would be completely mad for you to replace the existing activity.* (I)

Indeed, the importance and challenge of integrating BCt solutions into legacy systems is a widely discussed topic (Chong et al., 2019; Klimos, 2018; Lord et al., 2017); a common understanding is that BCt solutions will in most cases not operate on their own but in addition to existing systems (Hileman & Rauchs, 2017). More specifically, concerning our last point about systems running in parallel, it was interesting to find supporting opinions, for example that legacy and BCt solutions are likely to be combined in hybrid systems in the areas of clearing and settlement with a gradual transition (OECD, 2020) or speculations about a coexistence and progressive adaptation and reform taking as long as 20 to 30 years (Kaal, 2019; Priem, 2020).

Although Jordan and Silcock (2005, p. 191) in 2005 most likely only referred to intra-organisational issues, their argument can be transferred to issues of inter-industry BCt interoperability today. The risk that results from such a lack of interoperability is the inability of BCt to unfold its actual potential, as in relation to the application area of capital raising: *"The whole benefit of tokenisation is global liquidity. Having silo-based technologies on different locations on Blockchains is bad for the industry"* (VI).

Our findings highlight the current lack of (Hileman & Rauchs, 2017) and need for industry standards in security settlement, where the aim is to reduce the number of settlement layers using DLT. Here, in the worst case, a lack of interoperability could result in the

opposite effect, with in fact additional manual post-trading validations becoming necessary (Klimos, 2018).

Indeed, the lack of and fundamental need for interoperability between BCts (i.e. industry standards) is well known and frequently referred to in relation to different DLTs (ECB, 2021; Mazzorana-Kremer, 2019; OECD, 2020; Taskinsoy, 2019). We see two links between interoperability risk and other risk concepts. First, given that there are no common standards, the strategic risk of path dependency exists, as explored next, where one could choose the "wrong" standard. Second, evidence for the significance of interoperability risk is seen in its link to SPF risk, as part of the responsibility risk concept below: "*there is no unified* [custody] *solution to be used across all the institutions"* (V).

6.5.4 Responsibility Risk

Responsibility risk emerged from a number of categories related to the safeguarding (i.e. **custody**) and related risk of potential loss of valuable assets due to a loss of digital access keys – so-called "**private keys**" that grant access to a DLT. If kept in a central location, such as a crypto-exchange, which has been hacked in the past (Lord et al., 2017), the entire system is exposed to an SPF risk:

> *Custodian risk has always been the highest red flag, because the way you custody the assets in the digital world is very much different to the conventional world. Specifically, private key management, access to the key, single point of failure* […] *answering your question, what is the biggest risk, it's custody!* (V)

Here, we see a strong linkage to Jordan and Silcock (2005, pp. 125-126) "*information assets*" risk classification, which refers to the loss of valuable data, measured in both monetary and non-monetary terms. SPF risk is considered a crucial challenge especially in private Blockchains (Hileman & Rauchs, 2017), and we found that the rationale behind only one or few people being authorised to hold the private key was not necessarily operational efficiency but rather a consequence of the given business culture:

> *I've previously tried to engage people in financial markets about human factors (i.e. in investment banking, the human factor is the rogue trader) – they said, "no no no, this is just not applicable, you don't understand it, one person has to make the decisions".* (II)

BCt is often praised for the absence of an SPF, with cryptography for data encryption and hashing techniques being used in decentralised consensus mechanisms (Miraz & Ali, 2018; OECD, 2020), thereby fortifying the network against cyber-attacks such as a denial of service (Beck, Eklund, & Spasovski, 2019). Therefore, these findings about an SPF risk may appear paradoxical. However, consensus mechanisms rely on a large

number of network nodes, which, as explained in our evaluation on different types of Blockchains, we did not find to be the case given that, in practice, private Blockchains were applied in the analysed business cases. Therefore, operational risk of a central authority would in fact be concentrated in an SPF (Yermack, 2017), as supported by our findings: *"Somebody from the internal unit could steal the access keys, and as it is then done legally binding, you could do a trade without the company actually doing the trade – that's possible"* (III).

6.5.5 Regulatory Risk

Based on an existing explanation related to the clearing, settlement and custody process (Loader, 2019, p. 205), we understand **regulatory risk** as the uncertainty resulting from either a temporary regulatory vacuum (Paech, 2016), potentially filled with a new regulation, or a change in regulation, requiring either a seizure or significant re-engineering of existing business processes.

We previously investigated regulatory risk as part of the application area dimension and the concept of assumptions to obtain approval for a business case (page 106). We argued that regulatory factors and hence regulatory risk were pertinent in all business cases, as part of the goal dimension concerning political and regulatory reasons (page 125). Our findings are in accordance with a survey result that developers and network operators considered uncertain regulatory environments as the key challenge to the adoption of BCt (Hileman & Rauchs, 2017). As we will further evaluate in the environment dimension (page 144), this is why, in one business case, a non-domestic regulatory environment was chosen.

6.5.6 Strategic Risk

Four categories resulted in our concept of strategic risk (Table 29, page 135), of which we consider three. There are several linkages to Jordan and Silcock (2005, p. 52) risk class "*strategic and emergent risks*". This risk class refers to high-level decision-making concerning IT, for example: whether to adopt lower cost standardised solutions resulting in higher short-term profitability or to develop tailormade, more costly but business-aligned solutions in the hope of gaining a competitive advantage and higher profitability in the long run (Jordan & Silcock, 2005, p. 225).

We note a link between **competitor risk** and the goal of competitiveness, given that competitive pressures in a globalised economy can be considered as both a goal to reduce transaction costs and a threat if this is not accomplished (Zhao, Fan, & Yan, 2016). This risk existed in all of the analysed business cases, to different degrees and in

varying ways. For the business cases of the application areas bilateral security settlement and internal organisation, competitor risk concerned the efficiency of existing business models, with the risk of new market entrants with leaner cost structures capturing market share. In contrast, for the application areas capital raising and secondary market, competitor risk related more to the risk that "*someone finds a better way than us to do this"* (V).

We consider our second category, **reputational risk**, to be closely related to both competitor risk and the goal of competitiveness. On the one hand, especially amongst established financial institutions, there appears to be the risk of falling behind, *"So they put some money because they cannot lag behind the piers"* (I). On the other hand, active engagement in BCt bears a risk of reputational damage: "[…] *not because there is indeed a reputational risk but because we are pretty sure that not everybody is able to distinguish between cryptocurrencies like Bitcoin, whatever, and the Blockchain technology we are using"* (III). Akin to this, for a different business case from the capital raising application area, investors were cautious not to invest in tokenised equity, given the lack of regulation and uncertain regulation coupled with the fear of being subjected to fraudulent activity. Indeed, this regulatory uncertainty or "gap" in relation to Blockchain based assets is widely recognised (Ferreira & Sandner, 2021; OECD, 2020) and was the driver behind introducing new legislation, for example as in the jurisdiction of and explained to us by interviewee X. It is likely that these issues are temporary, and the risk should fade with regulatory gaps being closed and BCt progressively becoming better understood, not only by business professionals but also by customers and the general public. It is interesting to observe that neither of these two angles of reputational risk seems to have been discussed in the considered literature.

Our evaluation of **path dependency risk** follows from our analysis of industry standards, discussed as part of interoperability risk above. There, we considered the absence of common standards as a risk. Now, we consider the risk of selecting Sony Betamax instead of VHS cassettes (Van Steenis et al., 2016) and argue that although the goals of revenue opportunity and competitiveness may be strong, a first-mover risk exists. Hence, a flexible approach, as proposed in the following excerpt, is recommended:

> *I find very funny when someone right now in a very emerging market picks someone as the ultimate winner and this chain is going to win. The fact is we don't know what's going to come.* […] *So putting in standards in ways to migrate across chains, if in case this is ever necessary, or being very pragmatic on the way you do technological choices, is the only way to reduce risk.* (VIII)

To conclude, it is clear that risks were a significant aspect in the analysed business cases. BCt, in the space of security settlement and potentially beyond, certainly has the potential to reduce risks. Indeed, four of the 20 categories of BCt business case goals referred to risk reduction, culminating in the concept of risk management and reduction (summarised in Table 25, page 123). From the three widely recognised groups of risk in financial markets (i.e. market-related, credit-counterparty-related and operational-related risks), settlement-related activities are most frequently grouped under operational risk (Loader, 2019, p. 200).

In our business case analysis, we found that the technological ingenuity of BCt has the potential to significantly reduce these operational risks as well as credit-counterparty risk, just by reducing the number of intermediaries involved and by speeding up transactions significantly. However, it would be too simple to view BCt as a panacea for all kinds of financial market risks. In particular, the market risk that a certain, owned financial product loses significant value is beyond BCt.

From the diverse risks existent in financial markets (Loader, 2019, pp. 218-227), our business case analysis highlighted those surrounding the area of BCt. Some of these risks are independent of security settlement, such as project risk, whilst some are almost inherent in BCt, such as the fundamental need for interoperation between various BCts, and others are most likely temporary, such as regulatory uncertainties, because of the novelty of the technology and the regulatory lag.

We consider the analysis of risks in relation to BCt business cases as a valuable contribution to both theory and practice, as it allows for insight into the risks considered by those implementing the technology. Further research could assess specific risk categories and test, for example, how BCt has changed risk exposures for financial actors. Furthermore, the understanding of different risk concepts may be helpful for those implementing BCt business cases, both at their outset and during a later stage. Under consideration of the given, specific circumstances, certain risks may be neglected or accounted for. We ultimately suggest that the magnitude of perceived risks must be measured in relation to the potential of pursued goals.

6.6 Environment

Environment emerged as a dimension in the highest level of abstraction of our progressive coding process. As listed in Table 30, we evaluate two concepts, which led to this dimension. First, “internal environment” resulted from aspects that shaped the

business cases within the organisation. Second, "external environment" relates to aspects about the industry in which the organisation operates, including competitive forces, regulation and wider economic factors (Depietro, Wiarda, & Fleischer, 1990; Kiarie et al., 2018). As in the structure of our earlier evaluation, for each of the three concepts, we interpret our findings, highlight linkages and evaluate the applicability with regard to the business cases from the four application areas in light of existing literature.

Concept	Summary of evaluation
Internal environment	• Internal corporate environment
External environment	• Common standards • Regulatory environment • Market and cultural environment • Consortia • Review and Outlook

Table 30 Summary of evaluation: Environment

6.6.1 Internal Environment

As part of our evaluation of the business case process, we examined organisation-specific aspects of the internal design and practical set-up of business cases, suggesting that the internal organisational working environment was geared towards the BCt with a dedicated working group or isolated project team. This paved the way for the following considerations of the corporate or company environment in which BCt business cases take place. We saw different environments in which Blockchain business cases were conducted, from existing digital teams, as described in the following citation, to internal incubators and start-ups: "*Within the digital team, you always have a team that is relatively big that takes care of what is called 'change' and a smaller team that takes care of what is called 'innovation'"* (I).

We suggest that for all of the considered business cases, these different settings or **corporate environments** impacted all aspects of the Blockchain business cases, albeit in different ways, from their application area, goals and risks to the execution and even the involved stakeholders. One justification for this statement is a specific example of how the corporate environment affected the process of the business case; the following quotation underlined the close link between the corporate and regulatory environments:

> *So not only do you have to be good at working in a business environment, having good governance in place and good systems and controls. You also have to work in a way that's also acceptable under the given regulatory regime.* (VII)

Furthermore, support for our general statement can be found in the considered literature. For instance, the environment is discussed in relation to the general underlying IT infrastructure (Jordan & Silcock, 2005, pp. 52,206-209), as is the internal environment (Niu, 2018; Sachs, 2011, p. 43) and more specific units, such as in an enterprise management framework (Hui et al., 2017). Indeed, the interaction between the different dimensions is an interesting area, which we will explore as part of the development of a framework specifically for Blockchain business cases, in Chapter 7.

6.6.2 External Environment

Progressing from considerations about the internal corporate environment to considerations about the external industry environment, **common standards** constitutes one of the categories we found. On a corporate decision-making level, these standards, which BCt must follow, are closely linked to the previously evaluated interoperability risk and strategic risk. Regarding interoperability risk, we explored the danger that the full potential of BCt cannot evolve to create seamless settlement processes between organisations:

> […] *if you are a stand-alone institution, design all internal processes around that, you won't be able to trade with anyone else because the others do not have them. So you need some minimum standard to be accepted and implemented across your business trading partners.* (V)

These opposing and complementary perspectives on common standards appear to be a conundrum. On the one hand, there is the necessity for the industry to bring forward a common BCt standard, which would help every individual organisation to adequately adopt the new technology (Holotiuk & Moormann, 2018). Some findings indicate the presence of actors in certain parts of the financial market that want to work towards common standards (Mazzorana-Kremer, 2019). On the other hand, the prevalent cultural environment appears to disagree with such cooperation given that individual market participants are acting opportunistically with the risk of every individual organisation adopting any specific and potentially wrong standard. The benefits of cooperation amongst competitors to establish common standards has been long established (Osterwalder, 2004), with the recognition of resulting advantages such as greater market liquidity (Mazzorana-Kremer, 2019). The common consensus seems to be that industry consortia are best placed to develop such standards (Hileman & Rauchs, 2017; Van Steenis et al., 2016), which is in line with our findings: "*And some of these* [custodian] *companies were even thinking of creating a collective utility to manage these types of transactions*" (I).

Furthermore, our findings about the **regulatory environment** contributed to the external environment concept. In light of the above-mentioned conundrum, the question is pertinent, whether the government, if at all, can heal the challenge of establishing common industry standards, and if so, how? More generally, regulatory intervention (e.g. in the form of taxes and bans) has been seen to trigger the search for innovative alternatives to maintain or lower production cost (Depietro et al., 1990). Other research has shown an opposite effect, where regulation impeded technological innovation, for example in cases of governmental standard controls, which were slow to react to newer technologies, or where certain industries were protected from competition *(ibid.)*.

In fact, regulatory intervention, although with a different motivation, is already contributing to a degree of standardisation. When asked about the potential of a single Blockchain emerging, one interviewee answered as follows:

> *What would you need to do to make this COMPLETELY digital, in terms of, we don't have any human input at all? We would need a standardised API for our banking legacy systems, which will be built within the PSD2 projects.* (III)

Here, the reference is to the EU Payment Services Directive 2 (2015/2366), which was passed by the Council of the European Union on 16th November 2015, to be incorporated into member states' national laws by 13th January 2018. At the centre of the directive is the goal to increase consumer protection by reducing fees for online payments, with the aim to increase online security and market competition. As part of the latter strategy, banking data had to be opened digitally by 14th September 2019. Given this example, we argue that governments most certainly are in a position to shape the industry.

Considering the corresponding literature about the regulatory environment, we found a comprehensive review of Blockchain regulation (Kher et al., 2020), research on existing regulatory barriers to BCt (Priem, 2020), the call for certain regulation (Rosner & Kang, 2015) and explanations for regulatory gaps and policy recommendations (FSB, 2018; OECD, 2020). At the time of conducting our interviews, we found regulatory gaps, as already mentioned as part of our process dimension "before execution". We highlight three points reflecting these regulatory gaps as follows.

First, we found the requirement of substantial resources to work together with regulators, primarily to educate them on a topic yet unknown to them, to gain regulatory approval for a BCt-based financial product: *"It was totally new to the regulator, and we spent hundreds of hours educating* […]*"* (VI).

Second, the expert we interviewed from the regulatory body, notably from a different jurisdiction than the one referred to in the previous quotation, aimed "*to provide legal certainty and legal security to this new business sector*" (X), linking to the business case goal of political and regulatory reasons.

Third, we interpret the transfer of business activity out of a jurisdiction, even if it was the local one, into one that accommodated BCt more adequately, as a consequence of such a regulatory gap. This was the case in one situation, where the organisation legally located the transaction in a foreign jurisdiction because the local jurisdiction required signed paper documents, whereas the foreign jurisdiction did not.

Despite these regulatory gaps, our findings suggest that regulators are aware of the importance of catching-up with the market. Work on updates of current regulation and, in some jurisdictions, even efforts to experiment together with market participants are underway, for example in the form of so-called "sandboxes", which are digital testing environments in countries such as Singapore, Australia, the UK and South Africa (Corbet et al., 2019; Guo & Liang, 2016; Priem, 2020).

In reference to the general situation, participants stated, "*it's a special case*" (X); they described financial institutions' increasing acknowledgement that the **market and cultural environment** had changed and that they "*need to compete* [in] *high-margin value-adding products rather than standardized low-margin types of product*" (I). It is likely that one consequence of this increased competitive pressure is the search and adoption of BCt, as seen in both the goal to reduce cost and the strategic and emergent risk of not remaining competitive. Indeed, a higher intensity of competition was found to foster innovation generally (Depietro et al., 1990) and even specifically with regard to BCt and the need for financial service providers to innovate (Zhao et al., 2016). Therefore, we generally follow a long-standing argument of firms seeking to convert technological innovations into competitive advantages (Hamel & Ruben, 2000) and specifically confirm suggestions to deploy technology to advance products and services in response to competitive environments (Guo & Liang, 2016).

Market **consortia** were another industry characteristic that emerged. Following our thoughts about the risk of lacking common standards, such consortia could act as alternatives to established regulatory standards and be in a position to advance common standards (Van Steenis et al., 2016). However, our findings suggest otherwise:

"*Everybody's joined them, and maybe 30% of the people who joined them have now left them and have done their own thing!* (II).

Examples of consortia include HyperLedger, SETL and the ChinaLedger Alliance (Priem, 2020; van Deventer et al., 2018). Furthermore, the R3 consortium includes 200 members and uses its own open-source BCt "Corda" (*ibid.*). The Post-Trade Distributed Ledger Group, which includes approximately 40 financial institutional corporates, aims to share expertise amongst them (Priem, 2020; van Deventer et al., 2018). However, if individual members predominantly seek to benefit from their membership – with the overriding question and answer concerning consortia being, "*do we need R3 for all cases and the answer is, no*" (IV) – it is unlikely that consortia will be able to contribute significantly. This closes the circle to our earlier finding, namely that "*the nature of the financial services organisation will be to pursue its own financial objectives regardless.* […] *they find it very, very difficult to collaborate* […]" (II).

In summary, the critical risk of lacking common standards for the entire financial industry and its success appears to be recognised; at the same time, market participants are unwilling to cooperate to establish market standards. This lack of common standards is perhaps one reason why, as of mid-2019, publically "*there is no productive solution running in financial markets"* (IV). This statement refers to solutions of BCt beyond the scope of an internal business case. One of our interviewees succinctly **reviewed** the impact of BCt to date: *"I think it's still at the stage where this framework is being put together, so as much I wanted this to be around tomorrow, I realistically think, it's going to be time"* (V).

Nevertheless, even without operating settlement solutions between several market participants, across our findings there appears to be a shared opinion that a) BCt has already raised awareness amongst incumbents concerning their current business processes potentially being outdated and too expensive, and b) an engagement with BCt is important and necessary to maintain competitiveness: *"you can see all the CSD players, all the bookkeepers, they know they'll be out of their job, and they're already investing in the next solution"* (VIII).

Turning to an **outlook** on financial markets and specifically security settlement, answers were unanimous about the potential impact of BCt: "*I have no doubt!" (V)* that BCt will be "*Streamlining* [financial markets]*, making it much cheaper, faster, better for companies, for institutions for individuals – a dramatic change"* (VI). References to this point are

generally in accordance with our interpretation, although they suggest that given few successful business applications, organisations are "*optimistic but cautious*" (Chong et al., 2019, p. 1325).

6.7 Research Question II: Key Results

In this chapter, we answered our second research question, namely which key aspects were considered in the BCt business cases of financial institutions to implement BCt in the security settlement space, by analysing the findings of our inductive GT-based coding process. We followed the structure of our findings, which resulted in six main dimensions, each based on concepts and categories.

For the **application area dimension**, which included different **applications of Blockchain** in security settlement, we found four application areas: bilateral security settlement, capital raising, the creation of a secondary market and internal organisation. In our evaluation, we suggested that these application areas can be distinguished as follows: those where a Blockchain was used for assets native to the Blockchain and those where assets non-native to the Blockchain were utilised. This evaluation is in line with a known distinction between assets on-chain versus off-chain (BIS, 2017; Priem, 2020) but has so far not been explored in relation to business cases. From our research, we suggest that the application area and the distinction between assets native or non-native to the Blockchain take a central role within Blockchain business cases, influencing, if not determining various other aspects. To highlight one example where the Blockchain is used to establish a trading platform of assets native to the Blockchain, such as a cryptocurrency or equity token, rigorous regulatory standards are likely to apply, depending on the governing jurisdiction. In contrast, where non-native assets – theoretically all types of assets – are represented on the Blockchain, these are likely to be regulated in the off-chain world, and regulatory aspects to be considered in the business case will consequently be different and probably less critical. A less regulated or even internal organisational environment will entail different considerations as an open market environment. Moreover, the goals and risks of a business case using assets non-native to the Blockchain will inevitably be different.

Furthermore, we found that **descriptions**, **advantages** and **assumptions** for each of the four application areas were part of the application area dimension. Bilateral security settlement was described as the DvP of digital securities vs. digital cash, with the advantage of creating trust between parties otherwise unknown to one another. Capital raising was explained as the streamlining of the primary issuance process, with the

advantage of reducing the transaction costs of fractionalising assets. The development of a secondary market was described as the creation of liquidity, with the advantage of having a common shared infrastructure requiring fewer intermediaries than the status quo. Internal organisation was explained as the use of smart contracts to process assets non-native to the Blockchain in real-time batches, based on commonly accepted documentation mainly for the purposes of internal risk management, with the advantages of reducing the number of internal process steps and enhancing transparency. There were two assumptions underlying all the business cases from all application areas, albeit in different ways: the existence of commercial value in the BCt-based solution and the obtaining of approval both internally and, where required, also externally by the regulatory authority.

The business case **process dimension** emerged from the chronological concepts before, during and after business case execution. We suggest that strong linkages exist between the **before execution** categories “design and structure of BCt business cases” and “education and training” with the business case goal of fostering internal competences. Another category evaluated as part of the pre-execution stage was funding and financial calculations, which we will revisit in our discussion in Chapter 8. Here, our conclusions link our findings to those of previous business case studies, for example by Ward et al. (2008), showing that non-financial measures were applied because of a lack of data, in line with studies demonstrating the positive correlation between sample size and project pay-offs (Kohli & Devaraj, 2003). This was likely because the early stage of the technology created uncertainties about not only the technology itself but also the exact goals of the business cases.

As part of the concept **during execution**, we considered the practical set-up of the business cases and concluded that the chosen structures were closely related to the business case goals. Business cases launched out of research labs and incubators pursued goals of market monitoring and internal competencies more than business cases run out of a classical corporate structure, where cost reductions were the primary goals. Equally, the business case set-up in a stand-alone start-up predominantly pursued the existent business opportunity goal.

Furthermore, **during execution**, we classified the **node management** in all of the business cases considered as de facto private types of Blockchain with a prior pre-approval of participants taking place off-chain. The inapplicability of public Blockchains, if only for data protection and regulatory requirements, is commonly acknowledged

(Schuster et al., 2020; Van Steenis et al., 2016). We conclude that in some of the considered business cases, even if from a technological viewpoint, public permissionless protocol layer technology, both open source, such as Ethereum, as well as proprietary such as, Hyperledger Fabric was utilised, the practical pre-approval and KYC process and application of smart contracts arguably rendered all of the Blockchains private.

Furthermore, we evaluated the **challenges** of ongoing funding during the business cases. We concluded that the main reasons for this challenge were the changing business model of many financial institutions, which were generally less profitable in classical areas due to low-interest environments and more regulation, and the uncertainty of the BCt business case outcomes. This point links to the importance of senior management as a business case stakeholder. The second considered challenge, namely the integration of BCt into existing legacy infrastructure and other Blockchain standards, is discussed and linked to the business case risks and environment.

Finally, we conclude that the nature of the business case evaluation **after execution** depends mainly on the application area and whether regulatory oversight demands certain evaluation procedures. In these cases, we argue that regulatory evaluation prescriptions substituted internal evaluation procedures. Internal evaluation was more present in business cases of application areas concerning internal procedures, subject to less or no regulatory oversight.

In the business case **goals dimension**, from our 20 categories, we evaluated 10 resultant concepts. In Table 23 (page 119), we cross-referenced these 10 concepts with the four application areas. Some of the goals appeared explicitly, whilst others were more implicit. Based on our qualitative analysis, cost reduction, internal competencies, political and regulatory reasons and settlement speed were goals across all four application areas.

Concerning the concept of **cost reduction**, the potential cost savings of using BCt were the prevailing motivation in all of the business cases, although the specific way in which BCt was hoped to produce cost reductions and thereby motivated the business cases, differed. In one application area, internal cost savings were directly linked to the goal concept of **risk management and reduction** to improve operational efficiencies. In business cases of other application areas, the focus was on reducing the number of intermediaries involved in the issuance and settlement process and the standardisation

of contract terms. In most of the business cases, cost reductions were based on the possibility to code logic within the Blockchain in the form of smart contracts.

A noteworthy finding is that goals other than cost savings also motivated the business cases. However, these potentially peripheral or even ostensible goals may have been proclaimed in case the true goal of measurable and financial benefits did not materialise, which links to the research of Ward et al. (2008). However, for **internal competencies**, we suggest that this was a genuine goal linked to the external environment and the expectation of stakeholders that Blockchain will impact the market significantly such that proprietary competencies in this area are valuable. It also links with the goals of **business opportunities** and **competitiveness**. For these, the rationale was that BCt could be used to create service differentiation, for example through greater **settlement speed**. For a service as homogeneous as the settlement of securities, such a differentiator to attract market share and increase revenues is attractive. Concerning competitiveness, other linkages also exist. Both cost reductions and better risk management aim to increase profitability, most frequently by reducing personnel cost in overhead activities such as back-office trade conciliation, risk monitoring and management.

The goal concept **political and regulatory reasons** also related to all of the application areas, albeit in different ways. The two most compelling categories we evaluated were the setting of standards and regulatory reporting. For the former category, we found a link to the realisation of the long-term impact of BCt on the environment surrounding security settlement, causing organisations to pursue the goal of acquiring **internal competencies** to be in a position to shape the regulatory landscape. This was most likely motivated by the lack of fundamentally necessary regulatory frameworks for BCt to operate (Priem, 2020). Linked to the goal of revenue opportunities, political involvement was considered valuable to educate the domestic regulatory bodies to fill the existing regulatory vacuum (Corbet et al., 2019; Paech, 2016) and thus to be aware of likely regulatory changes to be able to gear technological investments in tandem with expected regulation (Weigelt & Shittu, 2016).

As for the category of regulatory reporting, we conclude that the regulator would ideally obtain a node and eventually change to a transactional regulation, which is closely linked to the goal of **market efficiency and liquidity.** We also considered this point in the external environment concept of the environment dimension.

The idea of firms lobbying regulators to impact regulatory changes to their advantage is well known and researched (Kerr et al., 2014; Kim, 2008). Whilst seemingly less academically scrutinised, the mechanism of supplying governmental agencies with consultancy and advisory services to implicitly take influence has also been investigated (Anastasiadis et al., 2018; Coen & Richardson, 2009, p. 53). Moreover, lobbying work has been related to new technology investments, and whilst inquiries have analysed the impact of the lack of regulation for BCt, even in the space of security settlement (Priem, 2020), the question of how lobbyism has already and is shaping BCt regulation, potentially in different jurisdictions, could be an interesting topic for future research.

For the **stakeholders dimension**, we conclude that the focus on **internal stakeholders** is closely linked to the goal of establishing internal competences and expectations regarding the development and significance of BCt for the market environment. The tendency amongst all business cases was for small internal project teams to be supported by experts from the wider organisation and senior-level management, whilst the involvement of **external stakeholders** was minimised. The presence of external legal advisors can be referred to the immature and unspecific regulatory landscape. Our finding that the regulator was an important external stakeholder links to the external environment and is discussed as part of this dimension.

For the **risk dimension**, we conclude that a number of risk concepts emerged from our findings. BCt has the potential to significantly reduce two of the prominent financial market risk classifications: operational risk and credit-counterparty risk. However, it should by no means be thought of as a remedy for the plethora of risks that exist in the security settlement process (Loader, 2019, pp. 218-227). From these various risks, our business case analysis revealed that a number of risk factors were considered and emanated from the business case implementation. We suggest that **project risk** and **strategic risk** exist independently of BCt and would similarly apply to any other IT-related project. Furthermore, **regulatory risk** and **new technology risk** are likely to be temporary, whilst **responsibility risk** can exist in private Blockchain set-ups despite BCt and **interoperability risk** is inherent in BCt.

The significance of interoperability, in other words, the existence of common BCt industry standards (environment dimension) is on the agenda of involved market participants (ECB, 2021); in addition, it could indeed undermine some of the most compelling advantages of BCt, such as faster settlement speed, global market liquidity and settlement cost savings. If siloed Blockchain technologies emerged, cumbersome trade

conciliation would have to take place (Klimos, 2018) when operating across different standards.

We consider the concept of responsibility risk to be prevalent in BCt. In the context of BCt, custody risk, which refers to the safekeeping of the private key, is a well-known risk in the realm of settlement (Loader, 2019, p. 220). It is critical if the private key is stored and can therefore be corrupted or stolen in one SPF. The decentralisation of nodes in a public Blockchain reduces this risk (Miraz & Ali, 2018; OECD, 2020; Schuster et al., 2020). However, our business case analysis confirms studies showing that this effect is not given where nodes are less decentralised, as in private Blockchains (Beck et al., 2019; Loader, 2019, p. 240). To conclude the subject of risks, we suggest that risks in BCt business cases act as impediments to successful business case implementations.

The **environment dimension**, as well as the stakeholder dimension, emerged from the concepts of internal and external environments. Concerning the **internal environment**, we found that the support of senior-level management was key for the success of BCt business cases. This concept is linked to the risk concept of new technology as well as the challenges encountered in the process dimension of producing measurable financial calculations. Concerning the **external environment**, we found a close link between common standards and the concept of interoperability risk, and we conclude that consortia could be in a well-placed position to establish such standards. Yet for this to take place, a more cooperative and less competitive mind-set appears necessary amongst industry participants.

7 The Blockchain Business Case Framework (BcBCF)

The purpose of this dissertation was to explore why financial institutions implement BCt in their security settlement businesses. To this end, we employed a GT approach to conduct and analyse interviews with experts about their underlying business cases. After our introductory considerations of existing business case models and frameworks and BCt in our literature review in Chapters 1 and 2, respectively, we explained the underlying constructivist research philosophy and inductive methodology in Chapter 3. Based on our findings, presented in Chapter 4, we answered our first research question concerning the suitability of existing models and frameworks for evaluating BCt business cases in Chapter 5, and our second research question regarding the key aspects that were considered in the implementation of BCt business cases in Chapter 6. We now turn to our third research question:

> *Research Question 3*
> *What could a suitable framework to implement a Blockchain technology business case look like?*

In this chapter, we first present the framework we developed inductively, based on our qualitative GTM and coding process. We discuss each dimension and the relationships between the dimensions. In Table 31 (page 157), we summarise the dimensions of our new conceptual framework, including a number of conceptual examples. In the final part of this chapter, we present and consider feedback on our framework, obtained from follow-up conversations with BCt business practitioners.

7.1 Dimensions of the Blockchain Business Case Framework

Our Blockchain business case framework (BcBCF) is based on both our understandings and the results obtained in the process of answering our first two research questions. In answering our first research question, we considered a number of technology models and frameworks and concluded that the BCRF (Maes et al., 2014) was the most suitable framework to evaluate BCt business cases. We reasoned this because the BCRF is in line with our research goal to establish a conceptual framework that provides a structure for the analysis of existing business cases, is focused on the space of IT business cases and is built on an extensive thematic literature review.

However, the BCRF analyses business cases per se, rather than business cases for a particular technology, and we hence saw a research gap. Consequently and in the light of Excerpt 5 on the virtues of a model, we consider a new conceptual framework

specifically dedicated to the analysis of BCt business cases to be a valuable contribution. It potentially offers a guiding structure for the implementation of new business cases for practitioners, and inspiration for further academic inquiries.

> *To be useful, a model must be both complete and parsimonious. It must incorporate and organize all of the previous research in the field, while, at the same time be sufficiently simple so that it does not get caught up in the complexity of the real-world situation and thus lose its explanatory value. Furthermore, it should have some predictive value.*

Excerpt 5 DeLone and McLean (1992, p. 87) on the aims of a model

Guided by the oben quotation, in our literature review (Section 2.2, page 17), we considered technology models and frameworks relating to business cases. We also studied models and frameworks outside of the business case space, including the technology acceptance model (TAM; Davis, 1989), which is used to determine if and why users adopt and use new technology; the IS success model (DeLone & McLean, 1992), which seeks to define IS success for organisations; the technology–organization–environment framework (Depietro et al., 1990), which analyses aspects that determine the process of technological implementations in organisations; business model frameworks (Osterwalder, 2004); and models geared specifically towards a particular technology, such as ERP systems (Basoglu et al., 2007). In line with these frameworks, the dimensions we found in our framework are interactive in the sense that they impact each other. However we realised that a detailed consideration of these non-business case-related models and frameworks was outside our scope of focusing on the analysis of BCt business cases.

In the light of this focus, we approached the goal of developing a dedicated framework with "*systematic knowledge*" and an "*open mind*", not an "*empty head*" (Dey, 1993, p. 65) – a commonly accepted and indeed recommended approach in the space of GT research (Urquhart, 2013, p. 38). Our framework is based on the six dimensions that emerged during our inductive GT coding process and the answers to our second research question regarding the key aspects that were considered in BCt business cases and the linkages between these. To reiterate, our proposed conceptual framework is based on the contextual, non-quantitative insights we obtained when interviewing BCt experts and analysing the obtained data using GT techniques.

In the subsequent explanation of our framework, we take every dimension in turn. For each of the six dimensions, we first describe it based on the evaluation of our findings

before considering the interactions between the dimensions. Where relevant, we highlight significant aspects for practitioners in their implementation of BCt business cases.

Figure 12 illustrates the BcBCF graphically. We suggest that all dimensions have a unilateral (i.e. one-sided) or reciprocal (i.e. mutual) influence on one another. To reflect these forces, we applied an interactive framework structure in line with other frameworks models such as the technology–organization–environment framework (Depietro et al., 1990) and the conceptual model of organisational adoption (Holotiuk & Moormann, 2018).

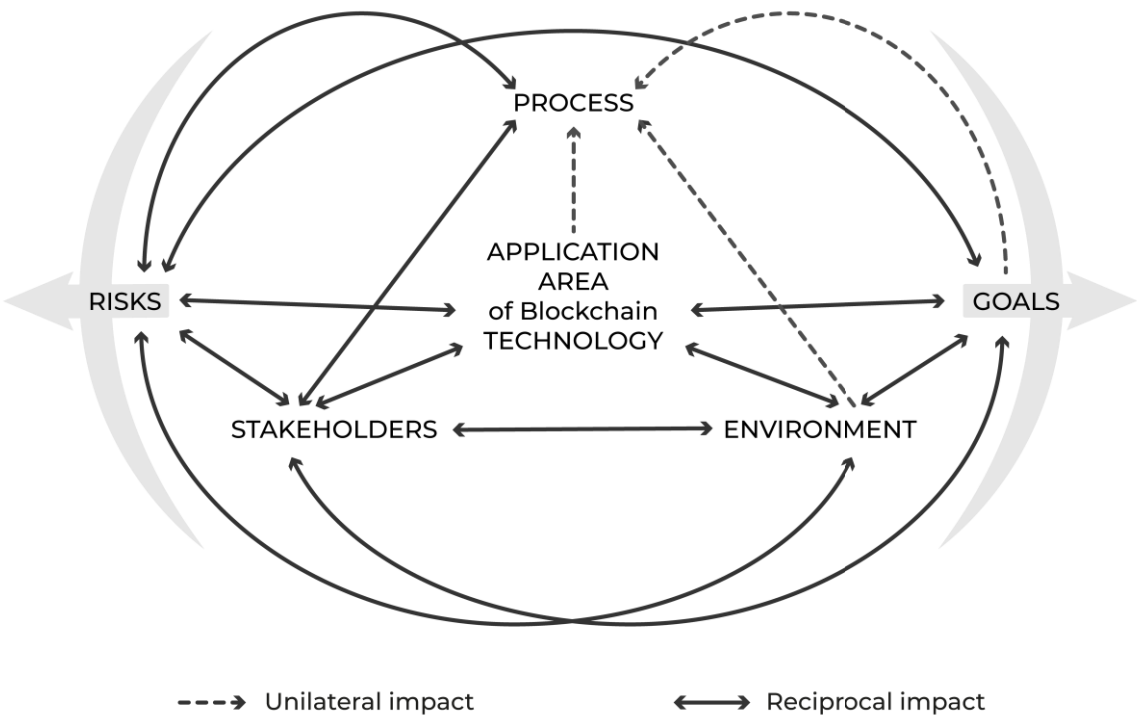

Figure 12 Blockchain business case framework (BcBCF)

Furthermore, in Table 31 we summarise the dimensions of our BcBCF. For each dimension, we present a selection of related concepts as well as corresponding examples, which emerged in our inductive coding process in Chapter 4 and our qualitative analysis in Chapter 6.

Main Dimension	Blockchain Business Case Framework (BcBCF)
Application area of BCt	Including descriptions, advantages and assumptions thereof. Examples: • **Native asset** settlement • **Non-native asset** settlement organisation internally
Process	Process steps of the BCt business case implementation, conceptualised before, during and after execution. Examples: • **Education and training**, internally (e.g. staff) and externally (e.g. regulator) • **Financial calculations** and funding • **Node management**, decentralisation of nodes • **Integration and interfaces**, internally and externally
Goals	Goals regarding the use of BCt (i.e. the "driving force" of the BCt business case implementation). Examples: • **Cost reduction** (e.g. through intermediation and operational efficiencies) • **Building internal competencies**, given expectations of long-term revenue potentials • **Risk management and reduction** • **PR and competitiveness**, given profitability targets and FOMO
Stakeholders	Stakeholders involved in BCt business cases. Examples: • **Project team** (internal) • **Senior and line management** (internal) • **Financial regulator** (external) • **Consultants and contractors** (external)
Risks	Risks that were considered and emerged as "a braking force" of implementing BCt business cases. Examples: • **Project risk** of the investment failing • **Interoperability risk**, given different BCts and a lack of industry standards • **Regulatory risk** due to the lack of legislation and uncertain development • **Strategic risk** (e.g. public relations and reputational risk)
Environment	Environmental aspects of Blockchain business cases, organisation internally and externally. Examples: • **Corporate** environment • **Market** environment • **Regulatory** environment

Table 31 Summary of the Blockchain business case framework (BcBCF)

7.1.1 Application Area

The application area dimension inductively emerged from the use of BCt, which reflects the purpose for which BCt is applied in the business case, as well as from the description of the application area, the advantages of using BCt over other technologies and the

underlying assumptions for a successful implementation. Therefore, we suggest that the dimension plays a central role in our framework, with all other aspects of the business case dependent on the application area. Comparable central dimensions can be seen, for example, in the BCRF (Maes et al., 2014) and in the technology–organization–environment framework (Depietro et al., 1990, p. 153), where the business case as such and the "*Technological Innovation Decision Making"* are at the centre of the frameworks, respectively.

We identified interdependent relationships between the application area dimension and other dimensions. We suggest that the application area for which BCt is used has a strong impact on all other dimensions and is impacted by almost all dimensions. Interdependency with other dimensions of the framework is recognised in a number of models, such as the ecology model (R. H. Miles, 1980, p. 375), as referenced and applied by the IS success model (DeLone & McLean, 1992) and the technology–organization–environment framework and its derivatives (Depietro et al., 1990; Holotiuk & Moormann, 2018). Furthermore, interdependent relationships between dimensions are known from feedback loops, as in models of technology transfer (Kiarie et al., 2018).

In some of the business cases we analysed, we found that a specific application area, or indeed the purpose for which BCt was to be used, was not necessarily given at the outset of the business case. Instead, senior-level management pursued certain goals either strategically (e.g. engaging in BCt to build long-term competences in this area and in public relations communications) or, arguably, emotionally (e.g. due to FOMO). In the latter cases, business case descriptions were less precise; there was also less understanding of the advantages of BCt and fewer assumptions of the application of the BCt. Accordingly, there was a relatively high project risk of the invested R&D budget not achieving any significant results within the given environment and with given stakeholders, internally and externally. Such a situation can most likely be attributed to the early stage of the technology, has likely changed since we collected our data and will likely evolve further with technological maturity and practitioners' clearer understanding about the advantages of using Blockchain. This argument is confirmed not only in more recent literature and market surveys (Pawczuk et al., 2020; Rauchs et al., 2019) but also through the feedback conversations we conducted with BCt professionals approximately two years after our interviews.

In other analysed business cases, the application areas were clearer from the beginning of the implementation. This was likely because precise goals were defined to solve a

specific problem. For example, in one of the business cases, the Blockchain was used to solve the opaque, slow and error-prone internal risk management system. In this case, there was a clear understanding of what the use of BCt should be at the outset, and the team was thus better equipped to plan the process, identify and manage risks and accomplish the desired results with the given stakeholders and within the given environment. In the future, it is likely that more specific goals, process experience, a mature environment and a sharper risk profile will result in more specific application areas of BCt. It can hence be assumed that all other dimensions will be considered in dependence of the application area.

7.1.2 Process

Within the BcBCF, we suggest that the process dimension integrates aspects relating to the implementation of the Blockchain business case, including the planning, financial calculations, business case execution and subsequent evaluations. The process dimension emerged from the chronological concepts before, during and after execution of the business case, comparable to the sub-dimensions seen in the literature review by Maes et al. (2014).

From our qualitative findings, we propose that not all dimensions interact with the process dimension reciprocally (represented with dashed lines in Figure 12, page 156). The application area, goals and environment dimensions appear to have a unilateral relationship with the process dimension. The process steps of the Blockchain business case implementation inevitably depend on the application area for which the technology is to be used; however, the process does not impact the application area. We suggest a comparable relationship between the process and goals dimensions and between the process and environment dimensions. In both cases the dimensions appear to impact the process but are unlikely to be impacted by the business case process.

We recognise that the distinction between unilaterally and reciprocally impacted relationships are subject to debate. In the course of the business case process, aspects may evolve that arguably also impact business case goals and the existing environment. For example, a lack of ongoing business case funding may result in an application area pivot and an adjustment of the goals. During the process, the education of the regulatory body may result in a specific business case process influencing the external environment. However, we found that these impacts take place indirectly, if at all.

Returning to the two examples of funding and education, the lack of funding arising in the process would be reflected in the impact and adjustment of the risk dimension, which in turn impacts the business case application area and goals. Equally, educating the regulator would be reflected in the reciprocal relationship between the process and stakeholder dimensions, which in turn would impact goals.

Reciprocal relationships can be interpreted between the dimensions of process and risks as well as between process and stakeholders. The process of the business case implementation is most likely to be complex, given not only an interplay between many constantly evolving software technologies (Holotiuk & Moormann, 2018) but also the impact of pre-set parameters. This is reflected in the impact of the environment and goals dimensions on the process dimension. Arguably the process itself should be considered as a risk factor to the implementation of the entire business case. At the same time, prevailing risks, such as strategic risks, were found to influence the business case implementation process, especially the planning and execution.

Concerning the environment, the process of establishing a financial model, for instance, most likely before execution, depends on the corporate environment in which the business case is carried out. Furthermore, the business case application area and goals will be key considerations in the implementation process, for example for the granted budget. Risks and stakeholders will have to be considered and, similarly, are impacted by the financial model. The feasibility and reliability of financial calculations will ultimately have to be considered in light of overarching assumptions considered as part of the application area.

7.1.3 Goals

The goals dimension resulted from the 20 categories of BCt business case goals and the 10 goal-related concepts that emerged in our inductive coding process. As a consequence, we consider the goals dimension to encapsulate the main reasons for the business case to be implemented. A dimension explicitly referred to as “goals” is rarely seen in technology models and frameworks; however, implicitly, goals in the sense of objectives, tasks and issues have a long history in the existing literature. For example, the ecology model of organisational effectiveness describes a so-called “goals-attainment” perspective (R. H. Miles, 1980, p. 362) and the “task/issue” dimension of the technology support group process model effectively takes the role of goals (Post, 1992). Furthermore, goals are a common element of higher conceptual levels, such as

"management", which aligns other dimensions to ensure that a specific goal is communicated and accomplished (Holotiuk & Moormann, 2018; Hui et al., 2017).

Given the organisational setting of Blockchain business cases in a competitive and mostly global environment, goals are most often likely to relate to an increase in corporate profitability (Holotiuk & Moormann, 2018), with the top priority of C-level management generally being "value" (Ward et al., 2008), either by a reduction in costs or an increase in revenues. Therefore, it is feasible to consider goals as "business case drivers", graphically represented by a rightward pointing arrow. Similar graphical representations can be seen in other models and frameworks, such as the IS success model and the model of organisational adoption (DeLone & McLean, 1992; Holotiuk & Moormann, 2018). Business drivers have been recognised and defined in relation to business cases, as both endogenous and exogenous forces that an organisation must deal with (Ward et al., 2008). Building on this description, we suggest the use of the term "business drivers" synonymously with the driving forces of the business case implementation, represented by a rightward pointing arrow to represent this force.

Our contextual findings indicate that goals can have a mixed relationship with other dimensions of the framework and should be considered as such. In relation to the application area, environment, stakeholders and risks dimensions, we suggest a reciprocal relationship. Goals, per se, appear to influence the application area, and similarly, the environment in which the business case takes place. Equally the specific stakeholders and risks are likely to be relevant.

Reciprocally, the application area of choice and the prevalent environment are most likely key considerations in determining the goals of a business case. Furthermore, existing stakeholders and prevalent risks are likely to impact the decision regarding goals in the planning and execution of the implementation. The relationship with the process dimension is likely to be unilateral, as discussed above.

Both in theory and in practice, it is likely that once the business case goals have been determined in the implementation-planning phase, the process itself will not impact the goals. However, during the business case execution, certain aspects are likely to arise, most likely related to risks and the environment, that could influence the process and the goals. Therefore, as explained previously, the process could arguably also be seen to impact the goals indirectly, and we would hope for a finer distinction of the inter-dimensional forces in further studies.

7.1.4 Stakeholders

At the highest level of abstraction, our conceptual coding process ensued in the stakeholders dimension, resulting from the concepts of internal and external stakeholders. As defined in our evaluation, we consider stakeholders to include people in a wider sense, including institutions such as a regulator (OECD, 2020) that can contribute to and/or have an interest in the success of the business case (Maes et al., 2014). We consider internal stakeholders to be those directly employed by the organisation implementing the business case, and everyone or everything else to be external stakeholders, for example advisers, consultants and a regulatory body.

In the light of the aforementioned understanding, based on our qualitative findings, a reciprocal interaction between stakeholders and all other dimensions of the framework applies. All dimensions are likely to impact the mixture of stakeholders participating in the technology implementation (i.e. who is involved) and the way in which these stakeholders behave.

Reciprocally, given that decision-making stakeholders such as “executive committees”, “senior management” or “C-level” managers are responsible for strategic decisions, stakeholders most likely influence the application area of the BCt business case. Given that these senior stakeholders tend to be in decision-making positions, they likely shape the organisations’ environment, suggesting a dependency here, too. Furthermore, depending on the organisation, senior stakeholders will also interact with “*business unit managers*” and “*operation managers*” (Maes et al., 2014, p. 53), who directly manage the business case process and its goals.

People themselves in different roles, such as employees and users, can be seen as a risk in the business case implementation. Their inability, unwillingness or unawareness are just a few possibilities that could result in difficulties with the business case implementation or, in the worst case, its abandonment. Likewise, the external regulator can be considered as an external stakeholder or, alternatively, as part of the regulatory environment.

7.1.5 Risks

The main dimension “risks” developed from a number of risk conceptualisations. We argued that project risk and strategic risk (Jordan & Silcock, 2005) apply to any technology-related business case. We further conceptualised that new technology risk

and regulatory risk are most likely related to the novelty of BCt, whereas interoperability risk and responsibility risk are most related to the nature of BCt.

We suggest viewing the risk dimension as a counterpart to the goals dimension. Employing an analogy where, based on our qualitative findings, we found goals to act as the driving motivations in the implementation of a business case, risks can be seen as the counterpart. Therefore, symbolically, risks can be interpreted as potentially decelerating the implementation process or, in an extreme case, causing its abandonment.

A reciprocal impact between risks and all other dimensions seems plausible. As for the potential impact of other dimensions on the risks dimension, the chosen application area, the business case environment and the goals of the business case are likely to impact risks, as conceptually grouped in the above-described risk concepts. For example, the business case process is likely to influence project risk, and stakeholders are likely to influence all concepts of risk. Similarly, the business case environment is most likely to impact various risk concepts; for example, the external environment could affect regulatory risk.

Therefore, based on our conceptual evaluations, different risk concepts influence all other dimensions of the business case. For example, strategic risk is likely to impact the application area and goals. Moreover, all risk concepts are likely to impact the process and environment dimensions, whereas project risk is most likely to have a strong impact on internal stakeholders in particular.

7.1.6 Environment

The environment dimension resulted from the abstraction of the concepts “internal environment” and “external environment”. Environmental factors were discovered to be meaningful determinants in various technology-related models and frameworks, such as in technology transfer (Kiarie et al., 2018), in technology innovation (Depietro et al., 1990) and in relation to the adoption of BCt (Holotiuk & Moormann, 2018).

We suggest a reciprocal interdependency between the environment dimension and all other dimensions, except for the process dimension, which we interpreted to impact the environment to a lesser extent, if at all. The environment in which the business case takes place should be considered depending on the application area and the set goals for the BCt, as these variables are likely to determine the prevailing industry

characteristics and market structure. Adhering to the aforementioned description of the environment, stakeholders inevitably shape the internal corporate environment.

As considered above, both the external and internal environments are likely to influence different risk concepts. Although the process of particular business cases could potentially indirectly impact the business case environment, both internally and externally, we do not interpret a direct impact.

Reversely, the environment, such as the level of competition, can impact the application area of a BCt business case. This assumption is supported by empirical evidence such as an empirical study on the patterns of e-business adoption amongst 6,964 companies in the EU27 countries (T. Oliveira & Martins, 2010). Various aspects of the environment should themselves be considered as risks, as they are likely to influence stakeholders, and from our contextual understanding, they should be taken into account for both envisaged goals and a planned process of a Blockchain business case implementation.

7.2 Research Question III: The BcBCF and Practitioners' Feedback

In this section, we reflect on our new conceptual framework by presenting practitioners' feedback. During the first half of 2021, we presented our Blockchain business case framework (BcBCF), together with our key conclusions, to a number of interviewed experts. The aim of these follow-up conversations, all conducted using video-conferencing software, was to obtain a "*reality check*" (Patton, 2002, p. 399) about our new conceptual framework. Prior to the conversations, all of the experts were e-mailed a one-page summary of the framework with a brief explanation of its dimensions, as presented in Appendix 10.5, page 208.

The feedback was structured in three points. We inquired about the criteria of **comprehensibility** following Jabareen (2009), whose definition of a conceptual framework, presented at the beginning of our work in Section 2.1, states the aspect of providing a "*comprehensive understanding of a phenomenon*" (Jabareen, 2009, p. 51 and 57). We also considered **practicability** to be an almost compulsory criterion, given that our research goal was to develop a framework, also for practitioners. Furthermore, practical applicability is a well-established criterion for frameworks (B. G. Glaser & Strauss, 1967, as cited in Orlikowski, 1993) and frequently seen in literature (F. Glaser, 2017; Mulligan, Scott, Warren, & Rangaswami, 2018). Finally, **completeness** is a criterion not only deeply anchored in qualitative research (Bryman, 2016, pp. 641,644) but also common for the evaluation of constructs such as frameworks and models

(Gregor, 2006; March & Smith, 1995). Excerpt 6 presents these three criteria in the form in which we approached the practitioners in the follow-up conversations.

From your practical point of view and experience with Blockchain business cases, how do you judge the framework's…

1) comprehensibility?
Which parts are easily understood (e.g. the content, the dimensions, the relationships between dimensions)?

2) practicability?
How useful could the framework be in practise to analyse existing business cases and to support the implementation of a new business case?

3) completeness?
What do you see as valuable, and what is missing?

We are curious to hear any other feedback and thoughts you may have about our findings/conclusions/contributions and the BcBCF.

Excerpt 6 Structure of feedback conversations

For our purposes, we considered other common criteria such as simplicity, elegance and ease of use (March & Smith, 1995) to be sufficiently captured by our criterion of comprehensibility. Equally, we considered consistency and internal and external validity (Gregor, 2006) to be covered by our criterion of practicability. In all of the feedback conversations, we shared our screen displaying our one-page summary (Appendix 10.5). We introduced the conversation with some general remarks about our research and inquired about how the experts' business cases had progressed over the past two years, refraining from explanations about our framework. We then reiterated the three feedback criteria and asked directly for their feedback. Their feedback is synthesised below.

7.2.1 Comprehensibility

Even without any explanation, and only referring to the one-page summary and our three feedback points, all but one of the experts immediately found the framework and its dimensions easily comprehensible. For example, the framework was stated to be well thought out, logical and easy.

We verbally explained the one-page summary for the one expert who was unable to immediately make sense of it. He then summarised that the framework shows the subject-specific and technological dimensions that must be considered for a business

case to be implemented without forgetting anything. He also stated that the arrows indicate the various relationships between the dimensions.

7.2.2 Practicability

The framework was considered to be practical as a tool to discover the potential efficiencies generated by a business case. One expert saw the value of the framework especially for new BCt business cases in the planning phase. According to his feedback, if the concepts were considered carefully and understood, several projects would not start, because the teams would realise the importance of the particular environment and consequential interoperability risk.

Another expert identified the framework's usefulness for the purpose of management consulting and explicitly referred to the challenge of communication during the planning phase of business cases. It was explained that in the context of educating and consulting management boards on an abstract level, about the topic of Blockchain and DeFi, the BcBCF would be highly useful even beyond the settlement process and possibly beyond the financial industry. It was further detailed that for the abstract concepts, such as autonomous economic agents, to be implemented using BCt, a structure was valuable for the communication of the various interrelated aspects to people who are less familiar with the subject matter and technology.

One expert explicitly praised the usefulness of the framework for portraying the interconnectedness of the various dimensions (i.e. arrows between them). However, another expert called the relationships between the dimensions irrelevant and felt that the arrows overcomplicated the framework. His reasoning was that as a practitioner, certain aspects must be considered regardless of their relationships to other aspects. He further suggested that the interdependencies would be more relevant at the more detailed level of the concepts, underlying the main dimensions, because these could be acted upon more specific in a practical context of the business case implementation.

7.2.3 Completeness

Apart from specific aspects that the experts asked about and added, as we detail below, the framework was considered to be holistic in its approach. Two experts suggested that the framework could be improved by providing a list of underlying concepts for each of the dimensions. This would render the framework even more comprehensive and practical, providing almost a detailed checklist of issues to consider throughout the business case implementation, especially during the planning phase.

In line with this feedback, another expert suggested that an index scoring system could be established from the framework. Using a detailed checklist, this could potentially allow for a scoring of and hence a mechanism for weighting each of the dimensions. The idea was that by inserting the details for a particular business case, the BcBCF could return an index that would aid in the decision-making process to select between different BCt business cases.

Beyond our synthesis of the feedback concerning the three criteria (i.e. comprehensibility, practicability and completeness), we selected five distinct feedback points from the conversations, as presented below. We selected these points based on our judgement about providing relevant and interesting confirmations and additions to our framework.

Feedback 1

This expert picked up on our conclusion about cost savings being a key business case driver and Blockchain as such being a public relationship risk to a BCt business case. This expert described a security settlement network he had heard of that is based on BCt, although it is not publicly confirmed as such. Eleven major UK banks had replaced their internal stock trading settlement teams, mainly responsible for overnight reconciliations to prepare trading books for the subsequent trading day, based on an interconnected Blockchain. Amongst insiders, this BCt-based network is said to be one of the longest operational implementations existent between financial institutions, running since 2016.

According to this description, the 11 institutions are each running hyperledger nodes for automatic reconciliation to take place. All of the stock trading activity between these banks is stored on the chain and is automatically synchronised amongst all of the participants, making the need for complex overnight reconciliations under consideration of the various systems used at each institution redundant. At all 11 institutions, the entire reconciliation team was dissolved. At one of the 11 banks alone, £20 million were saved annually, totalling a project cost saving of approximately £220 million p.a.

This feedback is highly interesting for three reasons. First, the expert explicitly explained and subsequently confirmed our finding of cost saving potentials being a business case goal and a critical driver, even as early as 2014, when the first plans for this network were initiated. Second, this feedback confirms the strategic reputational risk aspect that we had found surrounding Blockchain. At the project start, internally, IT experts had sold

the network to the 11 participating management boards as a “cloud solution”, knowing that, then and now, some decision makers would be sceptical and critical of Blockchain because of a misunderstanding about Bitcoin with its associations to non-transparent financial activities and the underlying BCt. Indeed only recently, the association of BCt and DeFi to intransparent and potentially criminal capital flows of funds was explained in a detailed briefing on the subject of DeFi (Economist, 2021). Third, this feedback contrasts with one of our found goals, namely that BCt is implemented due to FOMO, and the aim to use BCt to generate public relations. To date, none of the 11 institutions are officially confirming that this settlement system is run using BCt, which suggests that their perceived risk of public misinterpretation is greater than their perceived benefits of publicly advertising their use of a BCt-based settlement system.

Feedback 2

One expert confirmed our findings of classifying capital raising and the creation of a secondary market as BCt application areas within the security settlement space. The expert confirmed this because the BCt settlement aspect within these application areas was central.

Furthermore, the expert confirmed our conclusion to distinguish between application areas according to the distinction of native and non-native assets to the chain. The expert added the important goal of generating liquidity from a much larger investor base, for example from other jurisdictions otherwise unable to invest and trade at rational costs, when off-chain assets are represented with a digital asset such as an on-chain token. This feedback confirms the applicability of our results, which in this respect potentially apply to a larger space of BCt business cases beyond those selected as part of our inquiry.

Feedback 3

One expert talked about the perceived risk of incumbents losing revenue if security settlement accelerated from the current T+2 to T+1 or T+0 settlement days. This specific aspect was not mentioned in the one-page summary, so that this feedback itself can be seen as a confirmation of our finding that incumbents’ interests in this respect are a business case risk in implementing BCt-based security settlement. The expert reiterated that even in a low-interest-rate environment, the liquidity generated as part of the settlement delay, rolled over on a daily basis, was commonly used by various asset management divisions to generate revenue.

Feedback 4

One expert commented on the development of the business case in his organisation over the past two years, specifically the financial calculations of the business case. He confirmed that the business case had originally been financed from the development budget without classical financial calculations and project evaluation criteria being applied. The reason for this, in line with the research of Ward et al. (2008), was that financial benefits had not originally been the primary concern; instead, the measurable benefits of learning about the technology and the quantifiable benefits of better internal risk measurement tools dominated the decision.

Pointing out the dynamic nature of the environment, the expert explained that for some of the new BCt business cases, where more technological experience existed, a progressive shift towards more classical financial calculations was taking place. In these cases, cash flows and costs were predicted, aiming for a break-even as soon as possible. In this context, our framework's approach – weighing goals as a positive driving force against risks, to decide on a business case execution – was confirmed. The expert added that with greater maturity and experience of BCt, a shift is occurring towards purely financial considerations. This in turn links to the research of Ward et al. (2008) about different types of benefits.

Feedback 5

One expert re-emphasised the power and potential of BCt on the basis of the "shareability of the chain". We discussed this aspect (Section 6.5.3, page 137) and included interoperability as part of the risk dimension of our framework (Section 7.1.5, page 162). We argued that common standards were needed for BCt to unleash its full potential rather than operating merely as an alternative database technology.

In our conversation, this expert emphasised that decentralised systems, which require complex contractual work to take place under consideration of the given legal framework, were much more complex, not only technically but also and especially legally, than centralised ones. Even if solutions were technically functional, they were not necessarily legally functional, because of regulatory "gaps" or inadequate existing legislation (Ferreira & Sandner, 2021; Paech, 2016), with a substantial need to educate the responsible regulatory personnel. In fact, this expert's business case had been terminated because legal and regulatory challenges had not been overcome. The expert explained that the potentials of BCt were encouraging industry participants to overcome

the complexities inherent in the security settlement processes by establishing common standards.

In this respect, the expert explained how issues of governance structures in the interoperation between various participants had become relevant in the operation of the Blockchain. Governance refers to questions such as, who decides which additional network participants can enter the network? We had considered this aspect indirectly as part of the process dimension, by asking how the nodes of the Blockchain were to be managed. We had likely not found “governance” as such because, at the time of our data collection, none of the business cases under consideration had sufficiently progressed into operation.

8 Discussion

The goal of our inquiry was to discover the phenomenon of financial institutions implementing BCt in the space of security settlement, by analysing which aspects were considered in their business cases, as explained in Chapter 1. For this purpose, we applied a qualitative research approach using GTM to inductively develop concepts, as elaborated in Chapter 3. We presented the findings of our coding process in Chapter 4 and analysed them in Chapters 5 and 6 to consider the suitability of existing models and frameworks and the key aspects that were considered in implementing BCt business cases, respectively. In Chapter 7, we presented our new conceptual framework, which emerged from the concepts of our GT analysis.

This final chapter of our dissertation is structured according to our three research questions and addresses the following three areas: i) the availability and suitability of existing models and frameworks to analyse BCt business cases; ii) the key aspects which were considered in the BCt business cases, resulting in a decision to implement BCt and iii) a framework to aid in the implementation of BCt business cases.

For these three areas, we discuss our key findings, highlight our contributions to theory and practice, draw conclusions and propose recommendations for the implementation of BCt business cases. In addition, we present the limitations of our research in each area and offer ideas for further research where applicable.

8.1 Existing Models and Frameworks

Relating to our first research question, which asks what existing models and frameworks are available to analyse technology business cases and how suitable they are to evaluate BCt business cases, the first key finding of our inquiry was that at the time of conducting our research, there was no framework or model that focused specifically on the implementation (i.e. the planning, execution and analysis) of BCt business cases.

Moreover, relatively few models and frameworks focused on the business case as unit of analysis, such as the business case framework (Post, 1992), which is a framework for the development of a business case (Ward et al., 2008), and the business case research framework (Maes et al., 2014). The first frameworks and models to analyse BCt have been developed in the past five years, such as the model of organisational adoption (Holotiuk & Moormann, 2018); however, these do not specifically address BCt business cases.

We believe that the unavailability of a dedicated framework for BCt business cases is due to the relatively young nature of BCt, with merely an approximate 10-year history and a relatively recent entrance into the consciousness of corporate IT decision makers in 2016 (Hileman & Rauchs, 2017; Pawczuk et al., 2020). This corresponds to our finding that the majority of our analysed business cases, at the time of our interviews, were in a POC stage or had only recently moved into an execution phase. This is congruent with recent surveys (Rauchs et al., 2019). The number of business cases involving BCt is consequently still relatively small, and BCt business cases are still relatively under-researched. Additionally, we conclude that research and the establishment of models and frameworks are challenging in a field in which work is generally subjected to strict confidentiality policies, which reduce researchers' ability to obtain sufficient and reliable data (Littig, 2009, p. 103).

Concerning the suitability of existing models and frameworks, our conclusion is that the BCRF (Maes et al., 2014) is a highly valuable structure with which business cases can be analysed because it is built on an extensive study of a wide-ranging literature of technology business cases. However, the BCRF's angle of consideration focuses on the business case as vehicle itself, whereas our concern was the subject matter of specific business cases. Therefore, our work contributes to existing theory by showing that the implementation of BCt business cases, in the space of security settlement, is special in the way that it must be implemented under consideration of wide-ranging adjustments beyond the boundaries of the organisation, such as legal and regulatory changes. Different to other technology business cases, such as ERP systems (Basoglu et al., 2007), the business cases we analysed were not confined to organisations' internal procedures but were dependent on and have the potential to radically disrupt the industry environment in which they are implemented. We discovered that the implementation of BCt has the potential to change the risk exposure of counterparties in securities' transactions, compared to current business practice, which require an adjustment of wide-ranging legal, regulatory and business processes (Loader, 2019, pp. xi-xiii).

As a consequence, both in the planning and execution of BCt business cases, we suggest that practitioners should incorporate wide-ranging environmental factors within and beyond their organisation, paying close attention to both the existing regulatory requirements and especially aspects that are currently unregulated. Existing regulatory gaps currently bear the risk of cumbersome subsequent disagreements if they are not sufficiently respected and specified, preferably involving all stakeholders in the planning

phase of the business case (Priem, 2020). Therefore, a scenario and expectation analysis should ideally be performed, and corresponding strategies should be devised for different potential regulatory changes.

In summary, we conclude that, although there were frameworks and models for the analysis of technology business cases and aspects of BCt, such as its adoption, none of them was directly geared towards either analysing specific BCt business cases or assisting business practitioners in the implementation of a particular business case. Our research enabled us to develop such a dedicated new conceptual framework in answering our third research question.

We appreciate the potential limitation of a relatively specific scope, focused on the settlement of financial securities based on the knowledge of a specific target group (Flick, 2009, p. 169) – financial market experts with a specialisation in BCt – given that BCt is a technology potentially applicable to almost every area of our economy and even society (Laroiya et al., 2020). Although our research depended on collecting rich data, and this limitation is almost inherent in the nature of in-depth qualitative research (Charmaz, 2014, p. 32), we hope for future research to explore the suitability of our BcBCF to analyse business cases of other areas of the financial services industry and potentially beyond. In this regard, it would be interesting to compare the BCt business cases of different industries. For example, further research could aim to measure quantitatively the degree to which the various existing frameworks and models respect the key aspects existent in already-implemented business cases.

8.2 Key Aspects of BCt Security Settlement Business Cases

Concerning our second research question, which asks which key aspects were considered in the business cases of financial institutions to implement BCt for their security settlement, our research showed that a multitude of aspects were considered in the implementation of BCt business cases in the space of security settlement. We organised them into six dimensions, as follows.

8.2.1 Application Area

The first of these findings is that even within this specific area of financial security settlement, there appear to be different uses or application areas of BCt. We referred to these areas as bilateral security settlement, internal organisation, capital raising and secondary market. Ideally and as seen not in all, but in some of the analysed business cases, the application area was well described, with a clear understanding of the

advantages of using BCt in comparison to the status quo and alternative technological solutions, as well as the underlying assumptions to achieve the desired goals.

In the context of settlement, BCt was applied not only in the relatively apparent application area of bilateral security settlement between two transaction parties within a Blockchain network but also to less apparent application areas such as capital raising in the form of issuing financial securities native to the Blockchain. Given that settlement plays a central role in the primary issuance of assets, as in an equity IPO (SMPG, 2015), this classification appears justified, as confirmed in one of our expert feedback discussions.

Indeed, it is the settlement component of the security value chain that relies on the acknowledged BCt feature of so-called trustless transactions – more appropriately, the feature that less trust is required between transaction parties (Hileman & Rauchs, 2017), allowing parties otherwise unknown to one another to transact without the existence of a trusted third-party intermediary. We conclude that, if it were not for this feature of much lower transaction costs in the settlement process, the primary issuance and subsequent secondary trading of certain assets would not be economically feasible. Assets with insufficient value, relative to transaction costs, would consequently unlikely be fractionalised (OECD, 2020). In this sense, our research shows that the classical division of the financial security value chain (Figure 2, page 7; Frey & Burton, 2015) is disrupted by BCt and that execution, clearing and settlement are effectively being integrated, supporting past industry expectations (Workie & Jain, 2017). In this regard, we would hope for further research to consider how the roles of existing intermediaries is changing and how they are adapting. Some of them will disappear however the services of others, such as clearinghouses are fulfilling essential functions within the financial markets. Effectively intermediation and netting are ways of risk mitigation; it will be interesting to analyse how these mechanisms and services are provided for in a decentralised and more disintermediated BCt based financial market.

Another conclusion we draw is the possible distinction between BCt business cases concerning securities that are native versus non-native to the Blockchain. This distinction between on-chain and off-chain (OECD, 2020; Pelt et al., 2020) – in other words, assets that are native and non-native to the Blockchain – is well established, as in the area of tokenisation (BIS, 2017; Priem, 2020). To recap, for assets that are native to the chain, there is no parallel existence of the assets off-chain. A recently published European Central Bank (ECB) report supports our suggested distinction in the space of security

settlement. The report describes two different models: "*securities issued as native digital assets*" and "*securities issued in the conventional system and enabled in a DLT environment"* (ECB, 2021, p. 13).

The distinction appears relevant, given that several aspects reflected by the main dimensions of our conceptual framework depend on this distinction. Although we note that the distinction between application areas influences all of the business case aspects, some of the most pertinent dependencies relate to the environment, especially regarding the relevant regulatory requirements, the executed process in a technical and legal sense and the relevant risks. We acknowledge the limitation of our work that our interviews do not reflect all possible application areas. Moreover, in a space as dynamic as BCt, it is almost impossible to reflect future potential application areas. Therefore, we encourage further research to apply the distinction between native and non-native assets to the Blockchain to further BCt business cases, beyond the area of security settlement and possibly even beyond the financial industry.

8.2.2 Process

The second finding in relation to our second research question is that the business case process includes several aspects. We conclude that although a chronological consideration, as suggested by the BCRF (Maes et al., 2014), is well suited for some aspects, it does not apply to all aspects. In this sense, our work contributes by highlighting the following specific aspects that should be considered thematically.

Financial calculations and funding are important prerequisites for BCt business cases and, arguably, for any business case (Pawczuk et al., 2020; Post, 1992). Indeed, in the planning phase of the implementation, a business case as such was found to have the goal of securing sufficient investment resources (Maes et al., 2014). In theory, such calculations should be the condition (i.e. they should take place before execution) and an important basis for the decision to execute a business case (OECD, 2020); however, we conclude that for BCt business cases, other goals were equally important, if not more important. In fact, in most of the business cases under consideration, execution started without an initial investment decision in the pre-execution phase but rather with financial monitoring and funding decisions made on an ongoing basis throughout the business case implementation. This can best be explained due to the novelty of the technology and consequent uncertainties, the internal source of funding and the agile development strategies applied.

If financial profitability calculations were carried out, these were predominantly based on a cost–benefit analysis, with potential risks, such as project failure, weighed against potential outcomes, such as cost savings. Notably, we only encountered common project evaluation calculations, as for example return on investment (ROI) and internal rate of return (IRR) (Keen, 2011, p. 146; Messner, 2013, pp. 90-124; Post, 1992) in one of the business cases considered. In this case, such formal calculations were mandatory to attain regulatory approval. This coincides with a second study by an expert team at the University of Cambridge, Centre for Alternative Finance, who identified uncertain cost–benefit calculations to be the most important operational challenge of BCt in enterprise adoption (Rauchs et al., 2019).

We interpret this based on several interconnected aspects. For one, such an explorative approach can be explained by a lack of data on which to base classical project financing calculations at the time of our interviews, in line with earlier findings about the importance of sufficient data for positive IT pay-offs (Kohli & Devaraj, 2003). Furthermore, we saw that high-level decision makers pursued goals beyond those that were easily quantifiable, in line with business case research of Ward et al. (2008), most typically motivated by strategic long-term decisions and FOMO on a new technology potentially risking strategic competitiveness (Koens & Poll, 2018).

Allocated financial resources, regardless of the existence and/or reliability of financial computations, were consequently sourced as part of R&D budgets for BCt being a technology in an early, exploratory phase. Given that definite, quantifiable costs stood against uncertain, unquantifiable savings and revenue potentials, which would ultimately result in a negative case calculation, those in charge preferred not to carry out any typical business case calculations at all. The preconditions for this were structures in which they were not strictly obliged to do so, for example as part of a funded incubator. Linking to earlier studies about the advantages of non-financial appraisal methods (Kohli & Devaraj, 2003) and the work on business cases by Ward et al. (2008), our inquiry highlights that non-monetary reasoning is potentially better balanced in the form of goals and risks when analysing BCt business cases not only in theory but also in practice.

As a guidance for business practitioners going forward, we therefore propose that they base a decision to execute a BCt business case only on financial calculations that can be carried out with sufficient certainty. We see the danger of using financial calculations based on vague assumptions to support a business case that is in fact driven by non-quantifiable factors. That said, where costs and benefits can be predicted with sufficient

levels of certainty, the outcome of such calculations should be incorporated in the decision. However, even if a decision was made in favour of a business case implementation, we recommend that the process should be structured in milestones (Jordan & Silcock, 2005, p. 102) and that the funding should be adjusted based on an ongoing reporting and re-evaluation of goal attainment, with the flexibility to react built into the implementation process.

Our conclusion in this respect was confirmed in one of the follow-up feedback conversations. One expert explained this non-financial approach to be due to inexperience with BCt and high uncertainties surrounding the technology from a legal and technological viewpoint. With increasing certainty in this area, the approach was progressively changing to a more classical project evaluation and decision-making approach. It would be interesting for future research to consider how the decision-making of BCt business cases evolves in relationship with growing technological maturity.

Our findings suggest that the approval process of a BCt business case depends on its application area with the corresponding goals, risks and environment. Where BCt was applied for the settlement of securities in an isolated internal setting, only internal approval was required. However, where the technology involved bilateral financial transactions, and especially where BCt was applied to establish a platform for the issuance of securities with a potential asymmetry of information between those issuing and those investing, regulatory approval was predominant.

We conclude and suggest that approval should be obtained before business case execution, given that our findings revealed how the implementation process itself had to be geared and adjusted towards fulfilling regulatory requirements. Linked to previous work on the regulatory landscape for BCt (OECD, 2020; Priem, 2020), unless regulatory requirements are clear from the outset, there is a significant risk of executing a business case that will later need to be adjusted to adhere to regulatory requirements. If at all possible, such adjustments will most probably require more effort during the execution than if accommodated for at the outset. Further work could explore how exactly regulation or indeed the lack thereof has impacted BCt business cases in the finance industry and other industries.

We found that significant amounts of training and education of internal and external stakeholders took place before and during business case execution, especially where the business case was subject to regulatory oversight and approval. We conclude that

training and education should be carried out before and during business case execution, although these boundaries are vague. It appears sensible to offer sufficient amounts of training and education for all stakeholders, depending on the application area, the goals, the prevailing risks and the environment of the business case.

The decision regarding the node management and the type of BCt to implement was found to depend on the pursued business case goal(s). In addition to the common acknowledgement that public, permissionless Blockchains are ill suited for financial markets (Van Steenis et al., 2016), the majority of projects have restricted membership, and anonymity is unviable for regulatory and tax reasons (Schuster et al., 2020). Our conclusions support the idea that BCt is a widely applicable technology allowing for various forms of rights management (Rauchs et al., 2019). We suggest that the initial approval and consent to general terms and conditions, off-chain, as is common for private Blockchains (Hileman & Rauchs, 2017) and which was required for all analysed business cases, creates a base-level of trust.

Based on our findings, we argue that the institution administering the Blockchain transaction or settlement platform contributes to the trust that transacting parties experience. In this way, our study contributes to existing work, highlighting that BCt is not a panacea to eliminate the risks of financial security transactions. However, through the use of BCt, a trade can take place without an intermediary; hence, the risk – primarily credit risk – can be limited to the counterparty. The financial institution administering the Blockchain, although not acting as a counterparty in a legal sense, does play a role in the credibility of the trade, given that various other risks exist, such as technical performance and security risks inherent in the process of transacting (Rauchs et al., 2019).

As a recommendation for business practitioners, the type of Blockchain rights management (i.e. governance) should be defined according to the envisaged goals, preferably before business case implementation. This recommended course of action was specifically confirmed by feedback from one of the practitioners, who explained that only during operation of the BCt-based settlement network, had questions of governance become apparent. For exploratory business cases, where it may not be possible to define goals and issues of governance precisely at the outset, technological flexibility is recommendable, despite greater expected development costs.

8.2.3 Goals

The third finding in relation to our second research question concerns the goals of the business case. We conclude that, albeit in different ways, the primary goal of carrying out a BCt business case was to reduce costs. This conclusion ties into more recent surveys, for example where 72% of BCt implementations were aimed at reducing costs, closely followed by the pursuit of revenue potentials (Rauchs et al., 2019). However, we also conclude that the nature of cost reduction varied significantly between the business cases. Beyond various aspects of cost reduction, other goals included the creation of revenue opportunities, the fostering of internal staff competencies, improvements to customer service, public relations, incentives to influence policy making and an avoidance of missing out on a technological trend. In this respect, our research highlights the multi-facetted and complex motivations underlying the decision-making process within BCt business cases.

In most of the analysed business cases, we encountered the commonly acknowledged goal of cost reduction in the settlement process by disintermediating trusted intermediaries via an establishment of direct bilateral settlement of assets and cash (OECD, 2020; Priem, 2020). This finding and the magnitude of the cost reduction potential of BCt, especially with respect to personnel and IT costs, have been confirmed by a recent study that focused specifically on cost potentials in the post-trading of securities (Cucculelli & Recanatini, 2021). However, beyond this, we conclude that other cost reduction potentials can also be achieved through BCt. In one business case, the advantages of disintermediation were not limited to the settlement but extended to start with the primary issuance of on-chain securities, leveraging the cost advantages of BCt in the various settlement procedures involved in this process. In another business case, the goal was to increase efficiency to monitor VAR (value at risk). Here costs were reduced in two ways: by increasing the efficiency and interdepartmental transparency to monitor counterparty risk and by ultimately reducing potential write-offs (i.e. costs incurred by adverse credit events). We believe that these findings highlight the large and manifold potentials for BCt to contribute to efficiency gains directly and indirectly as part of the settlement process. Practitioners should therefore explore various aspects beyond those most commonly cited and aim to tailor BCt to maximise cost reduction effects for their particular business and institution.

Beyond the goal of cost reduction, all of the analysed business cases shared the goal of acquiring and augmenting internal competencies on the subject matter of BCt and practical skills concerning the technology and its implementation. We interpret this

finding to complement the more short-term goals of monitoring the market, marketing technological avant-gardism and senior managers' FOMO (fear of missing out), previously recognised in relation to BCt (Koens & Poll, 2018). Furthermore, our findings link to previous findings about the impact of regulation on technology investments (Weigelt & Shittu, 2016), given that companies were exploring BCt to have an impact on the regulatory development of the industry. Based on this, we conclude that although goals were ultimately derivatives of the chief aims of almost any for-profit organisation, namely to increase revenue and reduce costs, a large number of more specific goals, closely interconnect with the specific application area of BCt, existed.

Therefore, in the process of implementing a BCt business case, we underline the value of defining goals clearly in the pre-execution (i.e. planning) phase. The transparent communication of goals is key for the successful implementation of a business case. From our business case analysis, we saw that an exploratory business case, with goals geared primarily towards market monitoring, public relations campaigning and the development of internal competencies, and with long-term revenue potentials, is – and indeed should be – structured differently than a business case with the aim of, for example, building an internal risk management system or a digital asset issuance platform. The more precisely the goals are defined at the outset, the more likely it is that internal funding will be granted, external regulatory approval will be obtained and goals will be realised.

8.2.4 Stakeholders

The fourth finding in relation to our second research question was that stakeholders of the Blockchain business cases can be grouped into internal and external stakeholders, in line with the results of Maes et al. (2014). For the majority of the business cases, there were internal core teams of between five and 10 professionals, combining various skill sets and backgrounds, ranging from financial securities trading and back-office businesses to the technology side, with close involvement of senior management. We identified the aim to minimise the number of external stakeholders and linked this point to business case goals. In line with this finding, a recent survey showed that C-level executives are the second most common source (41%) for the origination of BCt projects (Rauchs et al., 2019). We consequently conclude that organisations see a wide spectrum of possible application areas for BCt and therefore wish to establish internal expertise and skills, even if the specific business cases are exploratory, with uncertain outcomes. We hence suggest that skills are considered to be purposeful for any future BCt activity, be it geared towards internal cost reduction or revenue generation.

This result relates to findings on the importance of human resource skills for the adoption of BCt, where 31% of surveyed participants considered a lack of in-house capabilities as a barrier to BCt adoption (Holotiuk & Moormann, 2018; Pawczuk et al., 2020). Our work highlights that in the space of new technologies, organisations are prepared to invest in a new technology with uncertain pay-off to train and specialise their staff.

Furthermore, we conclude that the degree to which external stakeholders are involved in a BCt business case is dependent on the application area of the business case as well as the size of the institution in which the business case is implemented (i.e. its environment). From our findings, the core team was supported with subject-specific skills and resources within and outside the organisation.

The area for which most external consultancy was sourced was legal expertise, followed by software engineering. We suggest that the strong involvement of legal experts in almost all of the analysed business cases is most likely related to the new settlement mechanisms offered by the use of BCt, without the involvement of intermediaries. Novel contractual agreements must thus be established in accordance with the governing financial regulator. Linked directly to existing and recent legal work, and emphasising the need for regulatory updates of the legal framework (Priem, 2020), our business case analysis revealed the requirement to educate regulators as part of the business case process. Such education is necessary both, to guide regulators and legal experts in establishing the required regulatory requirements for the business case environment to allow for the required process to be executed and the envisaged goals to be achieved. The legal complexity involved in DL frameworks and the necessity to respect regulatory feasibility were specifically confirmed in one of our feedback conversations.

For business practitioners, we recommend that they should be clear about the goals of conducting a BCt business case. If the technology is to be applied as a solution for a specific business problem as a stand-alone project, by the time of this publication, external vendors of BCt solutions may be available at a lower cost than the cost of establishing an entire team of internal specialists. However, if BCt is identified as the technology of choice for various applications areas, and the size of the organisation grants a dedicated team, we recommend establishing a strong, long-term commitment. It is advisable that experts from the business line for which a BCt-based solution is to be developed, should be teamed up with BCt software developers.

We suggest that such an internal project team of business experts and technology experts should consult with outside vendors, on a business case-specific basis, about possible components that can be sourced externally for the protocol, network and application layers (i.e. the technological back-end, the communication layer and the actual software application, respectively). Indeed, off-the-rack offers for all three layers have emerged in recent years: on the protocol layer, the open-source framework provided by the Enterprise Ethereum Alliance holds the majority of stored value (DeFi Llama, 2022), in comparison to other public frameworks, next to proprietary solutions such as the IBM Hyperledger Fabric; integrated solutions, including the network and application layers are for example, provided by Digital Asset Holdings and MarcoPolo (Rauchs et al., 2019). We recommend carefully balancing the potential costs of proprietary developments in the light of the pursued goals, in other words potential benefits should be considered on a risk-adjusted basis.

8.2.5 Risks

The fifth finding concerning our second research question is that the considered risks were diverse. In subtly different ways to commonly known IT project risks (Jordan & Silcock, 2005), the risk of project failure and the establishment of interfaces between new systems and legacy and external systems were found. Yet, in the space of BCt and security settlement, interoperability risk is specifically pertinent, as discussed below. The provision of an equivalently reliable and stable IT infrastructure as the status quo and regulatory uncertainties were risks conceptually found in respect of the novelty of BCt. Beyond BCt related risks, we highlighted that financial market risks that may exist, albeit in immediate settlement and with a practical elimination of counterparty risk (OECD, 2020), have to be accounted for. In conclusion, we suggest that risks should be considered closely in the planning phase of a BCt business case implementation, preferably in a subject-specific manner and in line with the application area and the pursued goals.

Beyond the risk of the BCt business case failing, for example due to inadequate planning, a lack of resources or mismanagement, our work underlined the multitude of risks involved in BCt business cases. We recommend incorporating and respecting three major sources of risks in the implementation of a BCt solution in the security settlement space: i) technological risk, resulting from the chosen architecture and system maintenance; ii) regulatory risk, resulting from the lack of specific regulation and ensuing uncertainties, as discussed further in the Environment dimension and iii) interoperability risk, with both internal and external legacy systems and interfaces as well as with other

Blockchain-based systems using different protocol and/or network layers. Indeed, the risk of lacking market standards and insufficient interoperability may be the most critical risk factors specific to BCt business cases. The tempting potentials of BCt are largely based on the efficiencies resulting from the interoperation of multiple institutions. Therefore, the risk is that these potentials are unattainable if interoperation is not achieved, as confirmed not only in one of our expert feedback discussions but also in a recent report by the DLT Task Force of the ECB (ECB, 2021).

8.2.6 Environment

The sixth and last finding pertaining to our second research question relates to several aspects concerning the business case environment. In this regard, the first conclusion of our work is that these aspects should all be considered. We found that i) the corporate, ii) the market and iii) the regulatory environments were considered in the analysed business cases. Therefore, for the planning and execution of future BCt business cases, we recommend considering environmental factors in the three aforementioned concepts (Depietro et al., 1990). Taking each in turn, our conclusion is that an internal corporate environment, with strong senior management commitment towards not only R&D but also the implementation and acceptance of new technologies, is critical for a successful BCt business case to be carried out.

Second, the market environment, with existing and future BCt solutions to be developed in the coming years, will determine the trust of market participants in both the underlying BCt and the solutions built upon it. Indeed, the full potential of some application areas will only be realisable if market participants cooperate to establish common industry standards such that assets native to the Blockchain can be traded and settled without confinement to any specific Blockchain. Closely connected and in interdependence, regulators will play a critical role in closing regulatory gaps, both to create the legal modernisation for BCt-based trading and settlement to be carried out at all, and to create the necessary legal certainty for transaction parties to switch from established trading infrastructures.

The critical importance of considering the regulatory environment for BCt business cases and the risk posed by regulatory developments and decisions was recently highlighted by the challenges Meta (operating Facebook) encountered with its Libra digital-currency; as a consequence of regulatory decisions, the 2019 launched project was effectively terminated in early 2022 (De Chant, 2022; Heath, 2022). We suggest that with increasing maturity of BCt, regulators will progressively close the “regulatory gaps”. Our research

revealed that this process may be accelerated by competition between jurisdictions, motivated to providing the legal foundations in order for DeFi (decentralised finance) businesses to thrive. In fact, the European Commission has proposed a regulation for Markets in Crypto assets (MiCA), which is likely to be enforced until 2023. The regulation foremost seeks to provide legal certainty, next to the support of innovation, consumer and investor protection and financial stability (Commission, 2020, p. 2). Only with such environmental prerequisites in place, will DeFi in a wider sense, and BCt-based settlement solutions, specifically, be accepted and their cost advantages, capital efficiencies and greater speed be materialised sustainably, in the long-term. Certainly, it will be interesting to monitor the market and study the changes of BCt business case characteristics before and after the introduction of legal regulation.

In summary, we consider our systematic collection, analysis and interpretation of obtained expert information about the aspects considered as part of BCt business cases to be a contribution for academic research and business practitioners. At the same time, we are aware that our work is subject to limitations. Next to the inevitable bias of our prior experiences and knowledge creating a degree of subjectivity in our interpretations, as discussed in Section 3.5, the selection of interview candidates, possible deviations in carrying out the interviews and language barriers must be considered as potential limitations, too. We devised a detailed strategy of candidate selection and ensured that we consistently carried out our data collection and analysis procedures as described in Sections 3.3 and 3.4, respectively.

To standardise the interviews, we conducted all of them in English language, however we acknowledge that this was not the native language of all interview candidates so that the communication of meaning may have been imperfect. Furthermore, the paralinguistic elements of our interviewees were not included in our data analysis. Paralinguistics refer to the non-verbal communication, such as laughter, other sounds of expressing feelings, face expressions and body-language, which are used to transfer meaning in a personal communication (Flick, 2009). These were lost in the process of transcribing our interviews and thereby arguably reduced the depth of the communicated content.

Moreover, we acknowledge that the generalisability of our conclusions is limited by the specific focus on the settlement of financial securities and the geographical focus on Europe. To compensate for this, we devised a data collection strategy that involved selecting business experts from different types of financial institutions in the settlement space and with a different range of functional roles. Each expert had long been immersed

in the subject matter; this meant that their answers reflected experiences beyond just one particular situation and, in most cases, incorporated more than one European jurisdiction. Nevertheless, it would be interesting to explore how the analysed BCt business cases relate to security settlement and differ from BCt business cases not only in other areas of finance, such as the payment industry, but also beyond finance.

We hope for further qualitative and quantitative research to be able to build on our findings and conclusions. For business practitioners, we hope that the considerations outlined will assist in the planning, execution and evaluation of real business cases and heighten the attention to potential risks in relation to given goals. We highlighted the technological risks concerning the BCt itself and other areas, especially the regulatory landscape. It would be interesting for future research to consider which risks equally existed at the outset of other nascent technologies. Furthermore, it will be interesting for future research to explore how BCt business case goals changed over time and to validate, possibly quantitatively, which factors resulted in successful business case implementations, with an attainment of the planned business case goals.

8.3 A Framework to Assist the Implementation of BCt Business Cases

We now turn to our third research question, namely, what a suitable conceptual framework to support the implementation of BCt business cases in the settlement space of securities could look like? Based on our consideration of existing business case models and frameworks and our qualitative GT-based conceptualisation of expert interviews, we proposed the BcBCF in Chapter 7 (Figure 12, page 156). We now draw three main conclusions.

The first conclusion is that, in our view, a framework to assist both the analysis and the implementation, including the planning, execution and evaluation, of a BCt business case, based solely on qualitative analysis, is useful. Indeed, this is in line with other frameworks that have been established in a similar manner in the past (Holotiuk & Moormann, 2018; Maes et al., 2014). Moreover, the comprehensibility and practicability (i.e. the relevance) of our new framework have been confirmed in follow-up conversations with business experts. Beyond its practical use, our qualitatively based, exploratory and inductive approach to find concepts and to establish a conceptual framework thereof can be seen as a basis for subsequent research and quantitative testing (Charmaz, 2014, pp. 323-324; Hesse-Biber, 2010, pp. 187-188).

At the same time, we acknowledge the limitation of our framework that beyond the feedback obtained by business practitioners, the framework has not yet been applied, stressed or validated in practice. For this reason, we would hope for further studies, possibly in the form of a case study, to analyse how the framework is used in the process of implementing a Blockchain business case.

The second conclusion we draw concerns the roles of specific main dimensions: the BCt application area, risks and goals. We suggest that the application area is at the centre of the business case, with the goals of the business case acting as drivers of implementation, and considered risks acting as impediments to commence or continue the implementation. This concept, especially graphically represented, appears to be a contribution to both theory and practice. Linking to the academic work of Ward et al. (2008) regarding benefits beyond quantifiable ones, such a graphical representation of various aspects could be the foundation for further research and the quantifications of goals and risks as an alternative to typical financial project evaluation procedures. Linking to the ideas of DeLone and McLean (1992) about the need for a framework to be simple, for business practitioners, the graphical representation is an easily comprehensible abstraction of the various aspects to be considered, as confirmed by the obtained experts' feedback. Indeed, one of the practitioners recognised the value of the framework as a consulting and education tool. The potential audience could be stakeholders, such as senior management members, regulatory staff and legal experts.

In its current state, our new conceptual framework is limited by the fact that goals and risks are not quantified. This links to the recommendation from one of the business practitioners, that a scoring system or a more detailed checklist for each dimension and a resulting business case index would be a valuable development of the BcBCF. Practitioners would then ideally be able to score an envisaged business case plan or existing business case, assigning values to specific criteria and calculating whether the sum of the assigned goal criteria is greater or smaller than the sum of the identified risk criteria. It appears logical that such a conceptual framework, ideally with a quantitative scoring system, is particularly valuable for business cases for new technology implementations because these tend to be surrounded by greater uncertainty, in comparison to well-established technology implementations, given a lack of reliable data and experience on which it would be possible to base classical financial project calculations.

Furthermore, future research could explore the applicability of the particular framework dimensions. Such an evaluation could take place as a case study, where the implementation of a particular business case, using the BcBCF, is closely monitored in a longitudinal business case study, as conducted in other business case research (Ward et al., 2008), and analysed to reveal which aspects of the business case are reflected by which dimensions of the framework.

The third conclusion we draw from establishing the BcBCF (page 156) concerns the way in which the six main dimensions of the framework interact with one another. From our qualitative research findings and analysis, we suggest that almost all dimensions unilaterally or reciprocally influence one another, as recognised in other frameworks (Depietro et al., 1990; Holotiuk & Moormann, 2018). We realise the limitation of our conclusions, since the relationships between the dimensions are based on qualitative data and the identified emerging concepts only. The coding process and data interpretation is subject to our subjective interpretations (Urquhart, 2013). The feedback of practitioners was mixed concerning the relationships, possibly reducing the comprehensibility of the framework. However, the predominant response was that the dependencies reflected the real-world complexities, the highly interconnected processes and the need to manage a business case holistically throughout all of its phases, from planning to evaluation. For research going forward, it may be interesting to test the magnitude of relationships between various dimensions of the BcBCF.

Indeed, a next step could be for future research to apply and test our framework quantitatively. We hope that with greater maturity of BCt, data on conducted business cases will become more readily available, allowing for such quantitative studies to be conducted. In alignment with one of the practitioners' recommendations to establish a scoring system and business case index, it could be interesting to measure the degree of dependencies between specific aspects of the six main dimensions. The applicability of such an index could be increased if the interdependencies between the dimensions were assigned specific magnitudes. However, this would require further research to investigate and measure these dependencies.

In the light of a rapid emergence of Blockchain-based solutions both within the finance space, now commonly referred to as DeFi and beyond, with corresponding ecosystems, it seems appropriate to consider BCt as a proven and valuable technology. Its relevance in our rapidly digitalising economies, accelerated by the COVID pandemic, which spread to Europe by early 2020, and a rapid adoption of digital payment methods, has never

been as prevalent as it is now. In line with recent related work in the space of security settlement (ECB, 2021), our research has highlighted the multiple aspects to be considered in a BCt business case, including the need for regulatory certainty and the significance of common standards to ensure the interoperability between various Blockchains. Future generations may experience a fully digitalised economy in which legal and regulatory barriers may have disappeared entirely.

In this sense, BCt may act as a driver for common standards to be created, whilst the necessity and inexistence of sufficiently compatible systems may be the primary reason for BCt business cases to be declined or indeed to fail. Considering the business case as the root vehicle for new technology implementation, if our new conceptual framework contributes to a more systematic approach to implementing BCt business cases, it may raise awareness of the various interconnected aspects and challenges amongst practitioners and thereby possibly contribute to greater industry standardisation. Aligned goals, standardised communication between stakeholders in an otherwise fiercely competitive environment and consistent processes could result in greater certainty and a reduction of currently experienced risks. Our hope is that a greater success rate of BCt business cases and their industry impact will ultimately contribute not only to private cost savings but also to the saving of valuable resources.

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10 Appendix

10.1 Letter of Introduction

Michael Maikowski

Research on Blockchain Business Cases

Dear Sir/Madam,

Many thanks for our initial phone conversation. I am extremely grateful for your offer to take part in our research and thereby help our research at the Technical University Berlin. Beyond this, I am certain that the final dissertation, to which you will have **pre-publication access**, will be valuable to (name of organisation) and the future of your Blockchain project.

I am sending you this letter to summarise the purpose, methodology and next steps.

Purpose
Over the past two to three years, Blockchain technology has gained increasing attention, both from businesses and from academia.

The purpose of our research is to investigate

1) How Blockchain technology has been introduced in the day-to-day business processes of financial institutions, specifically in the settlement of security trading;
2) What the underlying drivers of the business case are;
3) What results are visible and what conclusions can be drawn.

Methodology
We are conducting a qualitative research inquiry. As part of this study, we would like to conduct one interview with you, which will last between one and two hours.

Furthermore, it would be very helpful to obtain access to documentation regarding the business case, such as presentations, memorandums and even e-mail correspondence. We are especially interested in documentation concerning the business case calculation, including your underlying assumptions.

Next steps
Please find an NDA attached to this e-mail. Please let me know if you and your legal council require changes to this agreement. Otherwise, I kindly ask you to sign the NDA and return it to me in our meeting.

Thank you for agreeing to a meeting on **xxx 2019** (online / in your office). I am very much looking forward to meeting you. In the meantime, if you have any further questions concerning our research, please do not hesitate to contact me.

Yours sincerely,

Michael Maikowski
Phd Student

10.2 Confidentiality and Non-Disclosure Agreement

Confidentiality and Non-Disclosure Agreement

for a PhD Case Study on Blockchain Business Cases

Between

Company Name: _____

Principal's Name: _____

Title: _____

"**Company**"

and

Michael Maikowski
Fürstenweg 7, 67435 Neustadt Weinstraße
Germany

Phd Student at the Technical University Berlin
Chair for Information and Communication Management
Faculty VII Economics and Management
Straße des 17. Juni 135, 10623 Berlin

"**Student**"

This Confidentiality and Non-Disclosure Agreement (the "Agreement") will confirm the mutual understandings of the Student and the Company in connection with any information provided to the undersigned Student regarding information of the Company.

Confidential information ("Information") includes all data, reports, records, trade secrets, verbal communications, and/or other materials obtained from the Company both prior to and subsequent to executing this Agreement. Confidential Information includes all such information that has not been in the public domain prior to receiving this information from the Company, including any affiliations, contracts, financial disclosure, trade secrets, and the knowledge that the Company may be seeking to complete a transaction. In consideration for the Company furnishing the Information, the Student agrees to the following:

1. All information is considered highly sensitive and strictly confidential. Accordingly, the Student shall maintain such information in the utmost confidence. The Student shall not use or exploit the Information for any purpose other than analysing specific business operations with the aim to produce a case study as part of the students PhD thesis ("Thesis").

2. The Student shall limit disclosure and transfer of Information to its research department, on a need-to-know basis. Only that information, relevant to the Thesis, including full transcripts of interviews, will be published in the appendix of the final Thesis. For confidentiality purposes, the name of the Company, its location and its employees will be anonymised in the Thesis.

3. The Student shall make no copies of the Information provided hereunder except as provided in item 2 above.

4. The Student shall not hire away from the Company any of the Company's professional personnel, prospective employees, or affiliates.

The Student understands that neither the Company nor its agents or representatives make any representations or warranties as to the accuracy and completeness of any of the Information. The Student agrees that neither the Company nor its agents or representatives shall have any liability to the Student or its research institution arising out of or in connection with any Information.

The Term of this Agreement shall be for three (3) years. In the event of any breach of this Agreement, the Company, in addition to any other remedies at law or in equity that it may have, shall be entitled, without the requirement of posting a bond or other security, to equitable relief, including injunctive relief and specific performance.

This Agreement shall be governed by and construed in accordance with the laws of Germany, Berlin.

If all parties to this document are in agreement with the foregoing, please sign this Agreement which thereupon will constitute an agreement between the Company and Student with respect to the subject matter hereof.

Company	**Student**
_____	Michael Maikowski
_____	_____
Date: _____	Date: _____

Based on a template provided by Nolen (2018)

10.3 Schedule of Data Collection Activities

Time	Activity
October 2018	Finalisation of the research proposal.
November 2018	Submission of the proposal, amendments and approval.
December 2018	Contacting of Tier-1 and -2 contacts and scheduling of meetings with Tier-3 contacts.
January to December 2019	Conducting of interviews with Tier-3 contacts and transcription of the interview recordings.
March to December 2019	Data analysis and evaluation
2020 ongoing	Follow-up, feedback and potentially a second round of interviews in case, unanticipated questions must be answered.

10.4 Interview Questions

PART 1. PRE-EXECUTION PHASE	
1.	In what year and under what circumstances did the topic "Blockchain" feature in your organisation for the first time?
2.	How much later was a decision made to formally engage with this topic (i.e. when was it decided that resources should be deployed towards this new technology)? Did your organisation or parts of it face challenges on the way to making this topic a "formal" need? If yes, please describe.
3.	How did your organisation deal with the identified need, to evaluate the technology?
4.	As of today, please describe the business case concerning your implementation of BCt for your trading settlement?
5.	How many months (and years) after the first meeting on this topic of BCt did your organisation establish a formal business case (if at all)? Why do think this was achieved relatively quickly / what were the main reasons this took relatively long?
6.	In what ways did you base the BCt business case on previous business cases of your organisation? Do formal procedures exist in your organisation for the writing/establishment of business cases? If yes, would you describe this process as formalistic/theoretical or grown out of practice / practically orientated? Would you call your organisation adept at the process of establishing business cases at the outset of new projects and subsequently executing according to plan?
7.	Who designed/wrote and put together your internal business case? For example, - exclusively internal staff - exclusively external consultants - a mixture of both Please describe.

PART 2. CONTENT OF THE BUSINESS CASE	
8.	How did your business case develop from its first version to its final version? Did you experience a pivot (drastic change) in the process?
9.	What distinguished the **final version** of your business case **(used for the subsequent implementation)**?
10.	Was the business case an internal project, or was it a collaboration between your and (an)other organisation(s)?
11. a) b) c) d) e)	Please describe, in as much detail as possible, the content of the business case. - What **information** did you base the business case on? Who did you consult for the establishment of the business case? - What were the **business drivers** / motivations at the centre of the business case? (speed, cost, safety, customers' data, regulatory [KNC], privacy) - What **factors**, both organisation-internal and -external, did you consider in constructing the business case? - What **assumptions** did you (have to) make for the business case to be feasible? If so, please describe. - Did you identify **risks** in the business case, and if so, what were they?

f) g)	- Did you establish **objectives** in the business case, and if so, what were they? - What **operating procedures** did you establish in the business case to foresee/control the execution of the case in practice later on?
12.	Was the business case approved internally? Please describe the **approval process**. Was the approval immediate, or did management demand alterations / did the project team have to make alterations to the first proposal? If yes, please describe, what had to be amended?
13.	Please provide documentation concerning the business case. If possible, including - The **business case itself**; - Underlying **calculations**/spreadsheets; - **Information** underlying the case (e.g. consultants reports, research and technology reports and other materials used); - **Presentations** concerning the business case and the project during work in progress and the final presentation.

PART 3. EXECUTION OF THE BUSINESS CASE	
14.	Please describe in which of the four phases you currently see the business case and why? - Pre-execution phase - Execution phase - Evaluation phase - Case completed with corresponding results
15.	Considering this business case relative to other projects in your organisation, how would you describe its internal importance? Was its importance high or low? Please describe.
16.	In hindsight, do you think the internal prioritisation changed during the process? Please explain how this manifested itself; what happened (resources, management attention etc.)? Why do you think this changed?
17.	(If a shift in internal prioritisation occurred) How do you explain this change in prioritisation? (e.g. Internal vs. external factors?)
18.	Were there key events, internally as well as externally, that impacted the execution of the business case, and if so, what were they?
19.	Please describe the team that was involved in the project. How many people were involved in total? What were their backgrounds?
20.	Which were the departments involved in the execution? (IT, general management, trading, back office?)
21.	Please describe and explain the working together between the various involved departments.
22.	Do you think that this business case received the necessary internal attention? Why? Could the implementation have been accelerated by more team members or other resources? Please explain.
23.	Please describe and explain the work in progress on the business case.
24.	Please describe the execution of the business case in your organisation on a scale between "*planned at the beginning and perfectly implemented*" and "*constant adjusting to business needs on the way*". Why?

PART 4. EVALUATION OF THE BUSINESS CASE	
25.	Is a formal evaluation of the business case taking place, and if so, in what way?
26.	How and by whom is the evaluation of the business case taking place? Please describe the process.
27.	What criteria do you apply to evaluate the success of the business case? Are these general formal internal measures, or did you come up with these criteria only for this project?
28.	Please explain if you were "on plan" or, if the business case is still ongoing, if you are "on plan" with the execution. When did you deviate from your initial plan, and why?
29.	Given your evaluation criteria, do you rate the business case as successful? Does your personal view differ from this evaluation? Why?
30.	As of today, have you achieved the envisaged goals of your business case? Please explain.
31.	Was the establishment of the business case important for the success of your organisation's BCt implementation? If yes, why?
32.	What were the greatest challenges you overcame in the process of the execution?
33.	In hindsight, could your business case have differed in order to improve the subsequent BCt project execution? If yes, how?

PART 5. BEYOND THE BUSINESS CASE	
34.	How does (name of organisation) interpret the influence of BCt on the following over the past years? - financial markets - trading - settlement
35.	How does (name of organisation) view the influence of BCt on the following in the next couple of years? - financial markets - trading - settlement
36.	Is there anything else we have not talked about that you view as important for us to consider and integrate in our work on your business case of the BCt in your post-trade settlement process of financial securities? Please be so kind as to share with us.

10.5 One-Page Summary Sent to Expert Practitioners Prior to Conversation to Obtain Feedback on the BcBCF

PhD Thesis Title

Why do Financial Institutions Implement Blockchain Technology in Security Settlement?

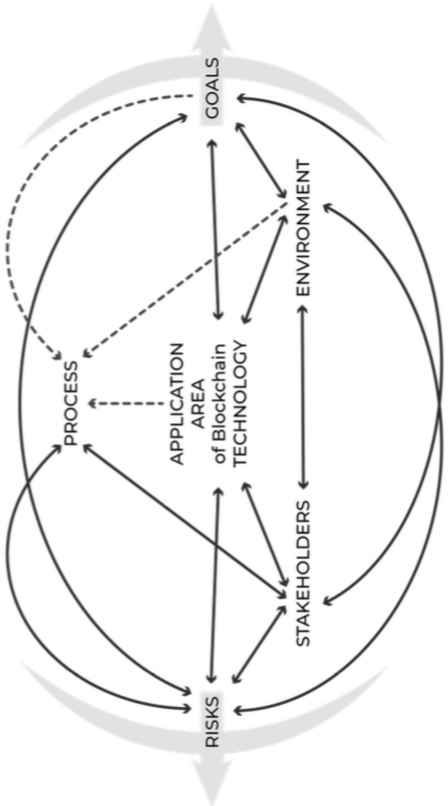
A Conceptual Framework for Blockchain Business Cases.

Technische Universität Berlin

Key Findings/Conclusions/Contributions

1) We found several application areas for BCt even within the niche of security settlement: **bi-lateral settlement**, **capital raising**, **the creation of a secondary market** and **internal organisation**. We suggest a possible distinction between BCt application areas depending on whether assets are **native** or **non-native** to the Blockchain.
2) The planning and implementation process included aspects such as **education and training**, **node management** and **funding** of the business case. For most business cases, we did not encounter common project financing calculations, either because the business case was originated out of R&D or incubator budgets without such a need or because of the impossibility to establish reliable assumptions in an environment of high uncertainty.
3) We conclude that the goals of a BCt business case acted as **drivers** for implementations, with **cost reduction** being the predominant goal; however, other goals were also found, including the **development of human capital**, the creation of **revenue opportunities**, the maintenance of **competitiveness** and a fear of missing out (**FOMO**).
4) We suggest that the risks of a BCt business case acted as **constraints** to implementation, with **project failure** being the predominant risk; however, other constraints were also found, including **legal and regulatory uncertainty**; the **reliability, scalability and performance of BCt**; **custody** (private key management); and **compatibility**, both with legacy systems and other Blockchains (i.e. "**no common standards**").
5) Internal stakeholders were found to dominate a BCt business case, most likely because of the goal to develop internal HR skills. Primarily under close patronage of **C-level management**, a core team of **business and technology experts** sourced expertise from their wider organisations, with external stakeholders only involved when necessary, such as for **legal expertise** and with **regulators**.
6) We found that the environment, both **internal** (corporate) and **external** (regulatory and industry), was a key aspect for a BCt business case. This may be because of the potential application areas of BCt and the possibility to remove the need for trusted intermediaries in the settlement process with a consequential complete reshaping of processes and risk allocations during settlement.

Blockchain Business Case Framework (BcBCF)



We hope for your feedback about the framework's:

1. **Comprehensibility** *Which parts are easily understood (e.g. the content, the dimensions, the relationships between dimensions)?*
2. **Practicability** *How useful could the framework be in practise to analyse existing business cases and to support the implementation of a new business case?*
3. **Completeness** *What do you see as valuable, and what is missing?*