



Norwegian University of  
Science and Technology

# Process Innovation with Blockchain in Banking

A case study of how Blockchain can change  
the KYC process in banks.

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**NTNU – Trondheim**  
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# **Process innovation with Blockchain in KYC processes in banks: A case study**

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Master thesis in  
Industrial Economics and Technology Management

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# Preface

This master thesis is part of the author's Masters degree programme in Industrial Economics and Technology Management at the Norwegian University of Science and Technology.

The author would like to thank the academic supervisor Professor Per Johnny Nesse and case supervisors Sverke Lorgen and Karl Christian Thomle for help and guidance throughout the duration of the project. The help and contributions are utmost appreciated.

A handwritten signature in black ink, appearing to read 'Jenitha Thavanathan', with a stylized, cursive script.

Jenitha Thavanathan



# Abstract

Innovation is the key to prosperity in competitive markets, as almost every significant business venture can trace its roots to an original spark of innovation, and on occasion, ground breaking innovation would foster a new way of thinking. Enter Blockchain, an emerging factor contributing to the industry's forced transition into a digital-first age. This thesis aims to uncover how process innovation with Blockchain technology can reinvent KYC processes in the banking industry today. This is as any other topic regarding Blockchain technology, only being approached by industry professionals. Due to its fairly young age, extensive research on Blockchain technology in KYC is sparse. In this thesis the IPO framework is adapted to business process change, in order to identify phases in the banks' KYC process that can be redesigned with the help of Blockchain technology. This thesis will hopefully provide more insight on steps necessary to take in order to successfully implement Blockchain technology in KYC processes in banks.





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# 1 Introduction

Innovation is the key to prosperity in competitive markets, and almost every significant business venture can trace its roots to an original spark of innovation.<sup>10</sup> On occasion, ground breaking innovation would foster a new way of thinking. Strategy, predicts how a competitor will react - especially when competitive markets are in unending flux,<sup>10</sup> and investment in financial technology (FinTech) at the moment is booming at unprecedented rates.<sup>11</sup> Mostly because those that seem to always react quickly to previously unforeseen opportunities<sup>10</sup> are determined to stay ahead of new waves of innovation. While the competition stands flatfooted these enterprises will succeed because they innovate. Technological advances are now forcing enterprise leaders to respond to change,<sup>10</sup> and one prominent example is the world of banking which is going through massive transformations (which they will continue to go through).<sup>11</sup>

In 2009 Bitcoin was introduced. Bitcoin is a cryptocurrency or "virtual-currency", an asset you can buy and use electronically. It is billed as a peer-to-peer electronic cash system and used for such transactions. This means through Bitcoins, electronic cash assets can be exchanged directly between two parties without being mediated by a financial institution,<sup>11</sup> which severely challenges the banks' strategic competencies. The technology Bitcoin is based on is called 'Blockchain'. The potential of Blockchain application outside of Bitcoin market was eventually recognized, and has since been adopted for several purposes by developers and investors.

Blockchain technology is emerging as another factor contributing to the industry's forced transition into a digital-first age<sup>12</sup>, as this new decentralized

ledger technology (DLT) now controversially has introduced a new possible reality. A world without the middle-man. Hence the question as if the need for a bank itself is being questioned with Blockchain technology. According to Reed<sup>11</sup>, there are two scenarios that can describe the structure for what can possibly happen; the banks end up being lost to these new and more efficient financial services that are in touch with the digital world we live in, and end up competing with the same financial services. Or, the banks focus on the customer and accept changes to their business model.<sup>11</sup> Once deemed cost-prohibitive, Blockchain has the potential to lower the entry barrier to certain industries or business functionalities. Subsequently, as you are reading this, a broad awareness of DLT is being incorporated into the banks' long-range strategic planning.<sup>12</sup>

Beyond Bitcoin and other cryptocurrencies, Blockchain offers tremendous potential to banking and other industries. Many banks around the world are in the process of creating - or already have created - a team or committee to study Blockchain's impact on their business models (naturally also looking at potential use cases).<sup>12</sup> They work together with other banks (this also includes the largest banks in the world) to share knowledge and ideas for using Blockchain.<sup>12</sup> In a way, this reminds us of the development of the Internet in the early 90s, before it became a mainstream commodity. Some of the potential benefits of this technology, include the following:

- Improved data integrity (reduced potential for human error/fraud).
- Increased transaction speed (close to real time).
- Reduced settlement risk (speed and simplification of processes).
- Opportunity for cost reductions.
- Improved data security and system resilience (there is no central point of failure).
- Reduced use of capital for reserves (capital not tied up for as long, if not at all).
- Opportunity to digitize sales transactions and contracts, and to mon-

itor the delivery of related goods or assets.<sup>12</sup>

Only by counting the number of conferences, events, and articles online, 2017 has quickly accelerated into a 'Blockchain-year'. Successful trial projects and pilots are being launched, and the notion of Blockchain being something new and difficult to conquer, seems to be dismissed as it is somewhat operational in certain areas, at least with successful pilot projects.

## 1.1 Personal Data Protection

### 1.1.1 GDPR

By May 2018 the EU General Data Protection Regulation (GDPR) replaces the current Data Protection Directive 95/46/EC. The aim of the GDPR is to protect all EU citizens from privacy and data breaches in an increasingly data-driven world that is vastly different from the time in which the 1995 directive was established. GDPR is the most important change in data privacy regulation in 20 years and is designed to harmonize data privacy laws across Europe, to protect and empower all EU citizens' data privacy, and to reshape the way organizations across the region approach data privacy. The GDPR applies to both organizations located both within and outside of the EU if they offer goods or services to, or monitor the behaviour of, EU individuals. It applies to all companies processing and holding the personal data of individuals residing in the European Union, regardless of the company's location.<sup>13</sup> The main changes to the regulatory policies are as follows:

- **Increased Territorial Scope (extra-territorial applicability):** As mentioned above the GPDR will apply to the processing of personal data by controllers and processors in the EU, regardless of the loca-

tion of the processing. It will also apply to the processing of personal data of individuals *in* the EU by a controller or processor *outside* the EU. The same way it will apply to non-EU businesses that processes the data of EU citizens (with a representative *in* the EU).

- **Penalties:** Breach of GDPR can result in fines up to 4% of the organization's annual global turnover (or a maximum of 20 million euros, whichever is greater). Also, a company can be fined 2% for not having their records in order, not notifying the supervising authority and individuals (citizens) about a breach, or not conducting impact assessment. These rules apply to both controllers and processors, meaning 'clouds' will not be exempt from GDPR enforcement.
- **Consent:** An individual must consent to data being used and has the right to rescind that consent at any time. Using clear and plain language, consent must be distinguishable and provided in an intelligible and easily accessible form.
- **Breach Notification:** Breach notification is mandatory in all member states where a data breach is likely to "result in a risk for the rights and freedoms of individuals".
- **Right to Access:** The individuals has the rights to know who has access to their personal data, what data has been made available, how that data is being used or processed, and to what purpose. The individuals also must be able to obtain (on demand and for free) a copy of the digital information that is undergoing processing.
- **Right to be Forgotten:** An individual is entitled to demand that the data controller erases any or all personal data held about an individual by that controller, cease further dissemination of the data, and potentially have third parties halt processing of the data.
- **Data Portability:** The right for an individual to receive the personal



data concerning them (which they have previously provided in a digital format), and has the right to transmit that data as they see fit.

- **Privacy by Design:** Privacy by design entails the inclusion of data protection from the onset of the designing of systems, rather than as an addition. Controllers are to hold and process only the data absolutely necessary for the completion of its duties (data minimisation), as well as limiting the access to personal data to those needing to act out the processing.
- **Data Protection Officers:** There will be internal record keeping requirements, and DPO appointment will be mandatory only for those controllers and processors whose core activities consist of processing operations which require regular and systematic monitoring of data subjects on a large scale, or of special categories of data or data relating to criminal convictions and offences.<sup>14</sup>

With the onus of personal data stewardship being given to the individuals themselves, they would not need to rely on a controller, issuer or processor to adhere to regulation to obtain, copy, move, transmit or secure their data as it is being done today. The individuals would own it and they would control the access. Blockchain helps achieve exactly that with DLT, meant to provide information that no distinct entity controls or manages. Because Blockchain utilizes a decentralized network of peers, where the history and current validity can be audited publicly (see chapter 2), it becomes a neutral, trusted and secure mechanism for self-managed user identity. The individuals will have complete access, the data will be trusted by third parties as valid (so that it can be used as easily as any physical identifier), and they can grant and rescind scoped access.<sup>15</sup>

### 1.1.2 PSD2

The Second Payment Services Directive (PSD2) is a fundamental piece of payments-related legislation in Europe (entered into force in January of 2016). All Member States must implement these new rules as national law by January 13th, 2018. PSD2 "aims to increase competition in an already competitive payments industry, by bringing into scope new types of payment services, enhance customer protection and security, and extend the reach of the Directive."<sup>2</sup> It is an important step towards making Europe fit for the digital age. It will allow retailers to "ask" consumers for permission to use their bank details. Once permission is given, the retailer will receive the payment directly from the customer's bank, with no middle-man actions (this direct connection between retailers and banks will be enabled using APIs).

## 1.2 Problem definition

This thesis aims to uncover how process innovation with Blockchain technology can reinvent KYC processes in the banking industry today. The goal is to explore aspects of process innovation and apply them to areas of today's KYC processes, but with Blockchain as the technical tool and the enabler of process innovation. This master thesis is written in collaboration with the Norwegian bank DNB, which has prominently influenced the research. Their insight and information has been critical to this study, as most of the developed stages of Blockchain projects being conducted around the world at the moment, are withheld from public eyes. Mainly because of first-mover/quick-follower strategies and tactics, but also because of early stages of testing.

Based on the problem description and the above mentioned scope, the main research question formulated will be addressed through-out this thesis. The main research question is defined as follows:

*How can Blockchain be used in KYC processes in banks?*

In order to answer this question, the following research sub-questions need to be answered as well:

**RQ1:** Can customer data be collected and registered in a distributed database?

**RQ2:** Can consensus be used to validate information?

**RQ3:** Who are the trusted intermediaries?

## 1.3 Structure of the Thesis

First, a conceptual background will be presented that includes theory on process innovation, Blockchain, KYC, and domains of use for Blockchain. Then, based on this, the conceptual framework driving the research questions will be presented. Further, the methodology of this study will be explained, providing an explanation of the identification, collection, and analysis of the literature, collection of case data, as well as the limitations of the chosen methodology. After which, an extensive in-depth descriptive analysis of the case will be presented along with the potential of Blockchain in KYC, followed by an evaluation of the thesis process. Subsequently, limitations to the study and further research areas will be identified.



## 2 Conceptual Background

This chapter will present relevant theory and concepts applicable for this case study. Definitions of Process innovation, Blockchain, and KYC will be introduced and further elaborated on.

### 2.1 Process innovation

The number of definitions for 'Process Innovation' in the literature is sparse, therefore by combining the definitions of 'Innovation' and 'Process' we can construct an applicable definition. According to Oxford dictionary,<sup>16</sup> a process can be defines as "systematic series of mechanized or chemical operations that are performed in order to produce something."<sup>16</sup> O'Sullivan & Dooley<sup>17</sup> define innovation as: *"...the process of making changes, large and small, radical and incremental, to products, processes, and services, that results in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization."*<sup>17</sup> Process innovation can thereby be defined as: *making changes in a systematic series of mechanized operations that produces a new and improved process for the organization, that adds value to their customers.* It is an investment into the company's skills, resources and competences, allowing the company to introduce cost saving changes in production processes, but also to introduce new technology which allows the production of a range of products quite different from the existing ones.<sup>18</sup> To further elaborate on process innovation we can take a look at the IPO framework of business process change.

### 2.1.1 IPO Framework of Business Process Change

A process cannot exist without inputs *to* process and outputs that come out of it, otherwise negating the sole purpose of a process. Where there are inputs, processes and outputs, there is a system. A system can be defined as "a coherent whole with a boundary, which separates it from everything else."<sup>1</sup> This means that the objects within a system are interrelated in an organized way. An example of such, is a natural system<sup>1</sup> such as the sun and the planets along their orbits within the solar system, all the cells that make up the human body, or even a human activity system[] of different elements that make up an organization. Regardless of what type of system we want, there are these three distinct types of objects (inputs, processes and outputs) we need to consider. Figure 2.1 shows how processes first receive inputs, and then combine and transform them into outputs, we call this the input-process-output (IPO) model.<sup>1</sup> If the system requires something from the environment it is called an input (f.eg. materials, people, money, information, etc.), and if the system provides something to the environment, it is an output(finished goods, services, information, money, etc.).<sup>1</sup> The boundary of the system defines the inputs and outputs of the system as a whole. Thus, when referring to process innovation, naturally it applies to the entire system.

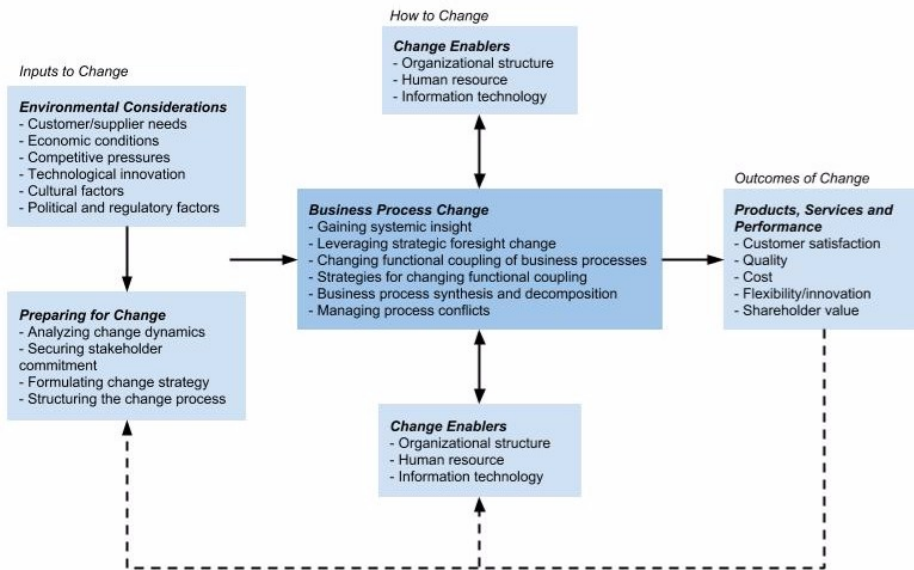


**Figure 2.1:** Input, process, and output (IPO) model.<sup>1</sup>

The IPO model in Figure 2.1 can be tailored for business process change by identifying business related inputs, process, and outputs. Figure 2.2 presents the IPO framework proposed to guide process change design and management. According to Grover & Otim<sup>2</sup>, the anticipated **outcomes**

**of business process change** (Figure 2.2) should be driven by business strategy. Oliver<sup>19</sup> defines an organization's business strategy as "understanding an industry structure and dynamics, determining the organization's relative position in that industry and taking the action to either change the industry's structure or the organization's position to improve organizational results"<sup>19</sup>. To elaborate further he states that industry structure and dynamics "determine the broad parameters of growth and earnings potential and delimit what is realistically possible to achieve."<sup>19</sup> What sets the firm's specific achievement profile and the scope of its strategic options, is the firm's relative position in a given industry structure. Therefore how a specific organization responds to its strategic (structural and positional) circumstance and aspirations, is defined by industry or organizational change.<sup>19</sup>

Strategy-driven outcomes help identifying specific activities and processes through which the organization can achieve its business objectives, also ensuring that the resulting business processes enable the organization to remain well aligned to the requirements of the business, social, and political environments in which it operates.<sup>2</sup> However, delivering the known requirements while still be able to deliver the future requirements as conditions change, will be a challenge.



**Figure 2.2:** The IPO Framework of Business Process Change.<sup>2</sup>

There are two factors to **inputs to change**; preparations for change and environmental considerations that affect the preparations for change. When preparing for change, assessing the organization's ability to efficiently and effectively deliver the new business process requirements is vital before embarking on business process change analysis. In addition to be able to deliver the requirements in such a way, it is also at the same time, important to maintain the agreed upon levels of performance within the current environment.<sup>2</sup> Thus, changes in the environment will naturally affect the preparations for change and so the organization must pay attention to factors such as:

**Change dynamics:** In order to assess the level of resistance to change engendered by the business process change initiative, analyzing change dynamics is quite necessary. Interaction among several antecedents might cause such resistance.



**Securing stakeholder commitment:** Getting the stakeholders involved in the change process can secure stakeholder commitment. In order to build a solid foundation for the change program, commitment from stakeholders is essential.

**Change strategy:** When the change dynamics have been assessed, a specific change strategy should be formulated. Such strategy can "either be evolutionary (the choice of either technical or social system first, or gradual, staged socio-technical change), or revolutionary (simultaneous change of both technical and social systems)." <sup>2,20</sup>

**Structure of change process:** In order for initiated change projects to succeed, proper leadership is required, <sup>21</sup> along with specific roles assigned to provide some degree of control and structure for the change process. <sup>22</sup>

Process innovation can also be regarded as an introduction of a market intelligence system that enables the company to become better at developing product innovations. <sup>18</sup> When business processes are properly designed they can help achieve efficiency and effectiveness for the organization. Subsequently, when they are designed to be innovative in a visible and dramatic way, it provides order-of-magnitude improvements in the way business objectives are accomplished, which might explain the continued strong interest in business processes among organizations. <sup>2,22</sup> Information technology (IT) is a potent **change enabler** of process innovation. According to Davenport <sup>22</sup> process innovation is an intermediate step between IT investments and economic returns. As a business, it is essential to recognize the need for improving business processes by responding better and quicker in order to remain competitive. The pace of change in the new digital economy puts such demands on today's businesses, and challenges them to reinvent themselves again and again. <sup>2</sup> According to Davenport <sup>22</sup> process innovation consists of five steps:

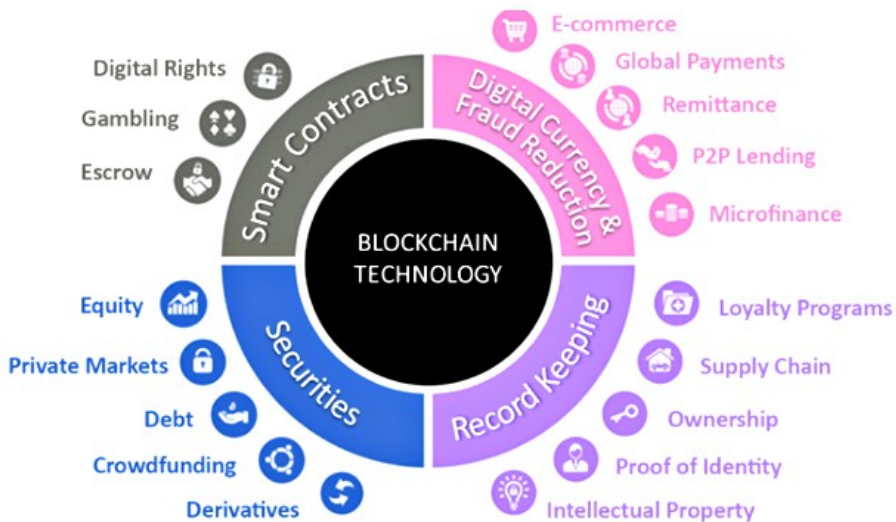
- identifying processes for innovation,
- identifying change enablers,
- developing a business vision and process objectives,
- understanding and measuring existing processes, and
- designing and building a prototype of the new process and organization

We see that these five steps are quite similar to the IPO framework of business process change shown in Figure 2.2. In chapter 5 a roughly combined, version for this case study will be used in the analysis.

## **2.2 Blockchain**

Currency transactions between persons or companies are often centralized and controlled by a third party organization. Therefore, making a digital payment or currency transfer used to require a bank or credit card provider as a middleman to complete the transaction. With cryptocurrencies, this all changes. With a decentralized environment created for cryptocurrency by Bitcoin, participants can now buy and exchange goods with digital money without any third party involvement.<sup>23</sup> Bitcoin currency was the first and only application of the technology behind it. Creating the possibilities for decentralized organization on a scale that we have never seen before, Blockchain technology has come to stay and cannot be uninvented.<sup>24,23</sup> It will help solve the issues with transaction systems that are typically centralized, where all data and information are controlled and managed by a third party organization, rather than the two principal parties involved in the transaction.<sup>23</sup> According to Oxford dictionary, a blockchain is "a digital ledger in which transactions made in Bitcoin (or another cryptocurrency) are recorded chronologically and publicly."<sup>16</sup> It is a decentralized ledger of all transactions across a peer-to-peer (P2P) network, where participants can confirm transactions without the need for a central certifying authority. Po-

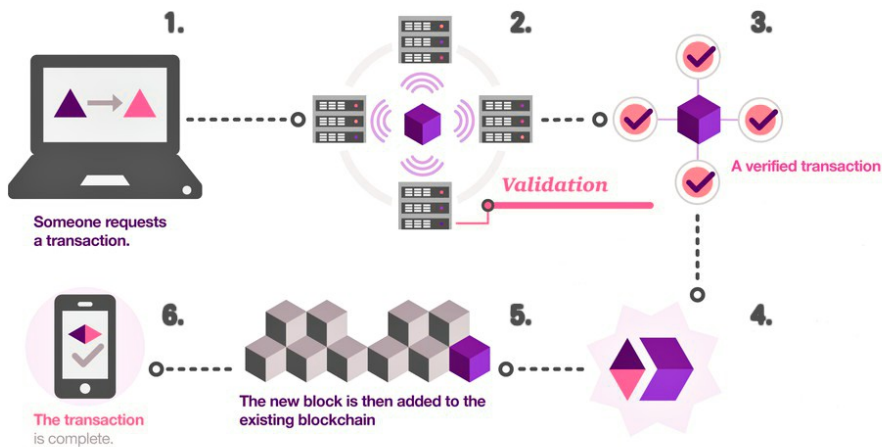
tential applications include fund transfers, settling trades, voting, and many other uses as depicted in Figure 2.3. These will be further elaborated on in Chapter 3.



**Figure 2.3:** Potential use-cases for Blockchain technology.<sup>3</sup>

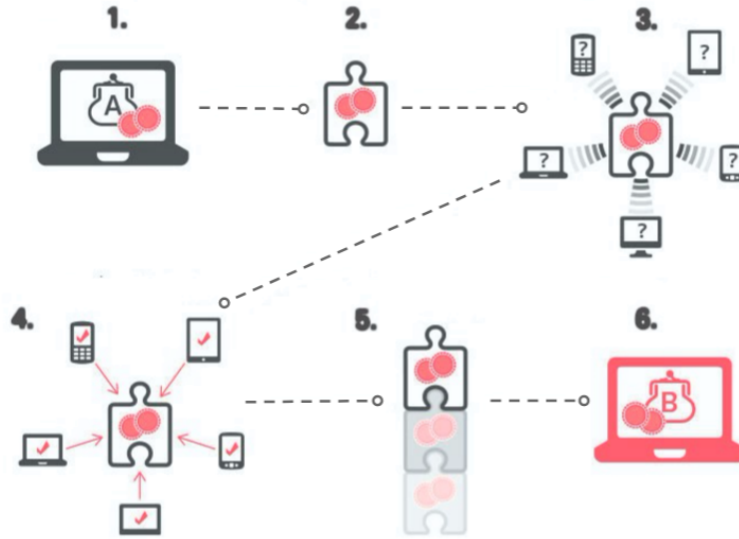
With Blockchain technology, virtually anything of value can be tracked or traded in real time (Figure 2.4 shows how this works). When someone requests a transaction (1), the requested transaction is recorded in a distributed ledger -including information of every transaction ever completed which is shared and is available to all nodes, making the system more transparent (than centralized transactions involving a third party). After the transaction is recorded in the ledger, it then gets broadcast to a P2P network (2) consisting of computers (nodes). This network of nodes provides access to synchronized copies of information that are continually being replicated, which makes the network highly secure and resistant to outages and attacks even though all entries can be viewed by anyone participating in the Blockchain. The network of nodes also validates the transaction

and the user's status (2) using known algorithms. Examples of such validated/verified transactions (3) are cryptocurrency, contracts, records, or other information. Once the transaction is verified, it gets combined with other transactions to create a new block of data (4) for the ledger, that maintains a continuously-growing list of blocks (forming a chain). Each block contains a time-stamp and a link to the previous block (the data in the block is encrypted and cannot be altered).<sup>25</sup> A new block is permanently added to the existing blockchain (5) and the transaction is now complete (6).<sup>4,12,23</sup>



**Figure 2.4:** From transaction request to completion with Blockchain.<sup>4</sup>

Figure 2.5 shows an example of a money transaction between Person A and Person B. Here, A wants to send money to B and requests a transaction (1). The requested transaction is recorded in a distributed ledger (2). After the transaction is recorded in the ledger, it gets broadcast to every party in the (P2P) network (3) that then together approve that the transaction is valid (4). The transaction now is combined with other transactions to create a new block of data and can be added permanently to the chain (5). The money is now moved from A to B (6).



**Figure 2.5:** Example of money transaction from person A to person B on a blockchain.<sup>5,6</sup>

### 2.2.1 Security

One of the advantages Blockchain has over a conventional centralized database is security. Blockchain relies on encryption to validate transactions by verifying the identities of parties involved in a transaction.<sup>26</sup> Every person or business involved in the network has a copy of the encrypted chain.<sup>25</sup> A hash (complex mathematical calculation) is performed each time a transaction is added to the blockchain, which depends on the transaction data, the identities of the parties involved in the transaction, and the result of previous transactions.<sup>26</sup> Because an encrypted chain is constantly being replicated across many different points, if one of the points on the network happens to be attacked, other points on the network step in and provide identical information.<sup>12</sup> In addition, the current state of the blockchain depends on previous transactions, which ensures that a malicious actor cannot alter past transactions. This is because if previous transaction data is

changed, it will impact the current value of the hash and not match other copies of the ledger.<sup>26</sup> In other words, false transactions cannot be added to the blockchain without the consent of the parties involved.<sup>26</sup> Further, if someone attempts to hack a blockchain to gain access to information on specific transactions, they would have to hack the entire chain -every point individually *and* simultaneously, which is virtually impossible. Subsequently due to no central point of failure, blockchains are presently presumed unhackable. Naturally, staggering applications are now being developed with Blockchain in the security industry. Some examples are:

- Personally Identifiable Information (PII) protection
- Company and personal digital identity and authentication
- Anti-counterfeit protection for electronics, luxury items and pharmaceuticals
- Single-sign-on and global "automated sign-offs"
- Malicious actor identification
- Verification software as a service
- Biometrically-controlled, multi-signature wallet applications<sup>25</sup>

### **2.2.2 Public vs. Private Blockchains**

Public blockchains or 'permission-less ledgers'<sup>27</sup> are open to the public and anyone can participate as a node in the decision-making process. Bitcoin is an example of this. The public ledger is not owned by anyone<sup>27</sup> and can be read from or written to by anyone who wishes to transact, which makes it an ideal place for public transactions between individuals who do not know each other.<sup>26</sup> Because it is not necessary for any approvals in public blockchains, they can be complicated to use and keep updated at the same time.<sup>11</sup>

Private blockchains function within a closed network. Everyone who interacts with the ledger is known<sup>11</sup> and the participants of the network are

usually obligated by legal contracts in their capacity to use the ledger.<sup>11</sup> This is because these blockchains might exist internally within a conglomerate of businesses or inside of one large company,<sup>11</sup> open only to that specific consortium or group of individuals that has decided to share the ledger among themselves.<sup>27</sup> Except the fact that the identity of anyone who attempts to access a private blockchain must be validated against a list of pre-validated market IDs, private blockchains behave in the same way as a public blockchain.<sup>26</sup> It is expected that private blockchains will dominate most commercial applications. The vast majority of commercial blockchain applications (particularly in capital markets) are likely to use private blockchains.<sup>26</sup>

## 2.3 KYC - Know Your Customer

In order to prevent identity fraud, money laundering, terrorist financing among other criminal acts, banks are required to put in place a policy framework - a thorough customer due-diligence (CDD) process, to know everything about potential new customers before opening any accounts or letting through any transactions. Such CDD processes must all be in accordance with "Know Your Customer" (KYC) regulations and policies.<sup>28</sup>

*"KYC entails the need for customer identification and the creation of audit-able evidence of due diligence activities."<sup>29</sup> "It highlights methods and processes for prudent customer identification, record keeping, identification of suspicious activities, as well as the need to report such activities to the appropriate authority for further investigation."<sup>28</sup>*

KYC applies to all institutions licensed to perform business transactions under the banking act.<sup>28</sup> Banks must validate that their customers are not, or have not been involved in illegal activities such as mentioned above.

In order to meet KYC conformity requirements they must:

- verify a prospective client's identity,
- maintain confirmation of the steps taken to identify their identity, and
- determine whether a prospective customer is listed on any certified lists in connection with supposed terrorist activities, money laundering, fraud or other crimes.

In essence, the bank needs to know the source of funds in a customer's account(s),<sup>30</sup> and in order to detect any activity that is contradictory with the customer's business (or income), the bank has to confirm the identity (and business) of the particular customer and then generate a profile on them.<sup>31</sup> Internal audit and compliance functions have important responsibilities in evaluating and ensuring observance to KYC policies.<sup>32</sup> Policies that usually incorporate customer acceptance policies, customer identification procedures, monitoring of transactions, and risk management,<sup>29</sup> shaping KYC as a continuous process that is not only limited to new customers, but also appropriate for monitoring current costumers as well.



**Figure 2.6:** Business flow of KYC processes.<sup>7</sup>



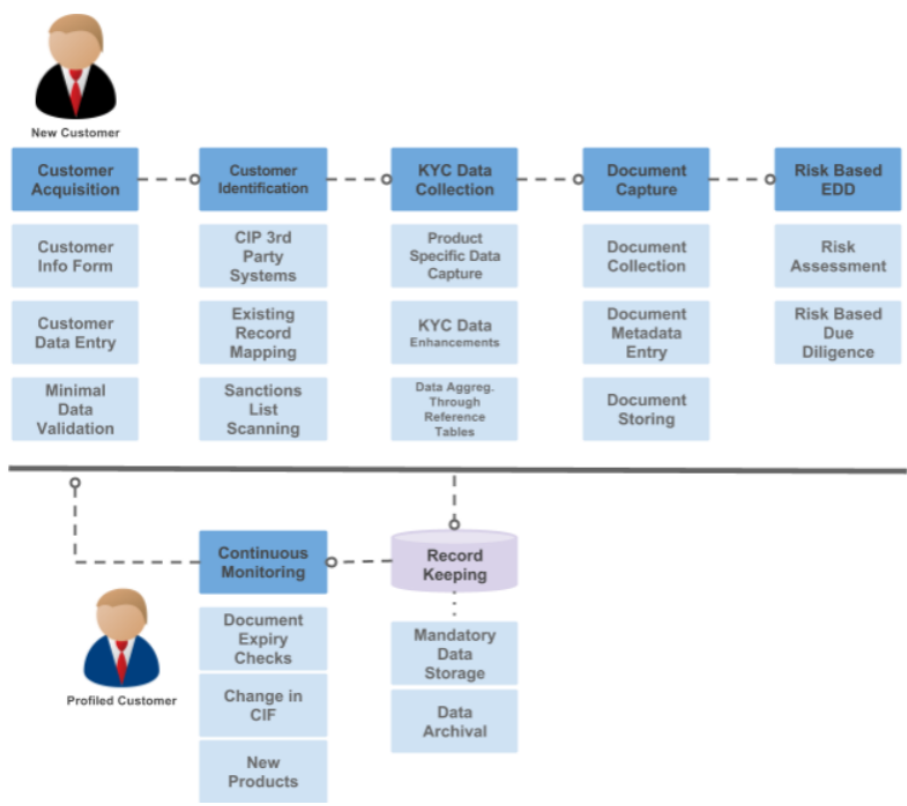


Figure 2.7: Oracle Know Your Customer Model.<sup>8</sup>

Figure 2.6 and Figure 2.7 together, explain the KYC processes within a bank when registering a new customer (on-boarding). The first step is to gather information about the customer. This is done by sending the customer a form to fill out. After-which, the identity of the customer must be confirmed by the bank through investigations. When the identity is validated, the customer's name and address is compared to sanctioned lists of suspicious or designated persons that are regularly produced by government agencies.<sup>31</sup> Because KYC enable banks to know their costumers and their financial dealings better, it will in turn also help the banks manage the costumer's risks prudently,<sup>2</sup> which is why a risk score is applied to the customer. This is followed by the customer on-boarding if the customer

is a new customer. Then, periodic reviews are conducted with continuous update of information, as well as monitoring of transactions to identify suspicious behavior.<sup>7</sup>

### 3 Blockchain 2.0

The concept of Blockchain 2.0 is used to describe domains of use for Blockchain technology beyond currency, finance, and markets.<sup>33,27</sup> The Blockchain 2.0 space is still in development, and there are many different categories, distinctions, and understandings of it, which is why standard classifications and definitions are continuously emerging.<sup>33</sup> Therefore, in this study, definitions and classifications available at the time of writing this thesis will be used. Blockchain 2.0 refers to the decentralization of markets in a more general sense, contemplating transfers of many other kinds of assets beyond currency, using the Blockchain all the way from the creation of a unit of value, through every time it is transferred or divided.<sup>33</sup> An approximate technological metaphor would be if we look at Blockchain 1.0 as the Internet Technology and its underlying infrastructure (such as the TCP/IP transport layer of the Web), and then look at Blockchain 2.0 as the services that can be built to run on top of it such as Amazon, Netflix and Airbnb (HTTP, SMTP, FTP, etc.) does on the Internet. Swan<sup>33</sup> states that it is important to note that these terms "are very much still in development and any metaphor might quickly become outdated...it might be like calling Chrome a 'Napster 2.0', or Facebook or AdBlock a 'Web Browser 3.0'."

Table 1 lists some of the different classes and examples of property and contracts that might be transferred with Blockchain. In theory, all financial transactions could be reinvented on the Blockchain.<sup>33</sup>

Classes	Examples
General	Escrow transactions, bonded contracts, third-party arbitration, multiparty signature transactions.
Financial transactions	Stock, private equity, crowd-funding instruments, bonds, mutual funds, annuities, pensions.
Public records	Land and property titles, vehicle registrations, business licenses, marriage certificates, and death certificates.
Private records	IOUs, loans, contracts, bets, signatures, wills, trusts, and escrows can be stored.
Identification	Digital identity can be confirmed with the blockchain through securely encoded driver’s licenses, identity cards, passports, and voter registrations.
Attestation	Proof of insurance, proof of ownership, and notarized documents.
Physical asset keys	Home, hotel rooms, rental cars, automobile access.
Intangible assets	Patents, trademarks, copyrights, reservations, and domain names) can also be protected and transferred via the blockchain.

**Table 1:** Blockchain applications beyond currency.<sup>33</sup>

This chapter explains the domains of use for Blockchain technology so far thought of, or approached to attempt at within financial services and contracts. Because it can be applied to almost any system operating on centralized information that can thrive on a decentralized ledger network, you will find, as you read through this chapter, that most parts of a functioning society can be subject to Blockchain technology.

### 3.1 Financial Services

Interfacing cryptocurrencies with traditional banking and financial markets is the most prominent area for Blockchain business,<sup>33</sup> as the financial in-

dustry has played the largest role so far in investing in Blockchain technology.<sup>11</sup> Many of the Blockchain start-up companies are in fact founded by bankers. NASDAQ, Visa, and JPMorgan are only a few of the big names providing assets to further developing of blockchain technology.<sup>11</sup> Venture capital-backed Ripple Labs is reinventing the banking ecosystem and allowing traditional financial institutions to conduct their own business more efficiently by using blockchain technology.<sup>33</sup> With sufficient amount of funds invested, companies can be able to explore how to commercialize Blockchain technology in order for it to handle the trade of stocks, bonds, loans, derivatives, and other assets.<sup>11</sup> Table 2 shows a several startups' and/or larger companies' blockchain projects or partnerships.

Company	Projects/Partnerships
Ripple Labs	Lets banks transfer funds and foreign exchange transactions directly between themselves without a third-party intermediary. <sup>35</sup>
Coinffeine	Aims to make it possible for end users to buy and sell Bitcoin directly without an exchange. <sup>36</sup> Invested in by Spanish bank Bankinter. <sup>33</sup>
BTCjam	A decentralized blockchain-based peer-to-peer lending.
Tera Exchange	<ul style="list-style-type: none"> <li>- Launched the first US-regulated Bitcoin swaps exchange.</li> <li>- Make it possible for investors to buy Bitcoin contracts directly through its online trading platforms.</li> <li>- Includes Tera Bitcoin Price Index, an institutional Bitcoin price index.<sup>40</sup></li> </ul>
Kraken	A Bitcoin exchange that has partnered with a bank to provide regulated financial services involving Bitcoin. <sup>39</sup>
PayPal	Announced in 2014 a partnerships with three major Bitcoin payment processors: BitPay, Coinbase, and GoCoin. <sup>37</sup>
Braintree (PayPal acquisition)	Is working on a feature with which customers can pay for Airbnb rentals and Uber car rides with Bitcoin. <sup>38</sup>
Vaurum	Is building an API for financial institutions to offer traditional brokerage investors and bank customers access to Bitcoin.
Medici	Aims to provide a decentralized stock market for equity securities in the blockchain model. <sup>42</sup>
Swancoin	121 physical-world artworks crafted on 30x30 cm varnished plywood, are available for purchase and transfer via the Bitcoin blockchain. <sup>51</sup>

**Table 2:** Blockchain projects and/or partnerships.<sup>33</sup>

Blockchain may be the key to preventing major financial crises. The real-time updating and transparent access to the distributed ledger make it con-

siderably easier to get accurate understandings of market value. This prevents the dangerous and inaccurate speculations and provides for more honesty and truth in the reporting how the market is faring. With a trustworthy and neutral source providing data accessible to all on the heath of the market, the risk of uninformed or unscrupulous deals being made that exploit the ignorance of the other part is significantly lowered. Furthermore, with different forms of handling data in the first place, Blockchain technology has the potential to level some of the inequalities that league societies across the globe; this is because people will have access to new forms of market participation and new types of information that can be capitalized upon and sold for profit.<sup>11</sup>

## 3.2 Smart Property

Blockchain technology can be used for any form of asset registry, inventory, and exchange. This includes all areas of finance, economics, and money. These are both hard/tangible assets (physical property), and intangible assets (votes, ideas, reputation, intention, health data, and information). This will open up multiple classes of application functionality across all segments of businesses involved in money, markets, and financial transactions. Thus, with blockchain technology, property becomes 'smart property' transactable via smart contracts (subject to existing law).<sup>33</sup> Because any asset can be registered as a digital asset on the blockchain, its ownership can be controlled by whomever has the private key. The asset can then be sold by the owner by transferring the private key to the buyer. Smart property transacted with blockchains is completely new. In fact, cryptographically defined property rights that are self-enforced by code, is indeed an alien concept.<sup>33</sup> Below are the common most thought of tangible and intangible assets.

### 3.2.1 Intangible assets

Intangible assets entails votes, ideas, reputation, intention, information, stock shares, reservations, or copyrights (books, music, illustrations, digital fine art etc.)<sup>33</sup>

**Personal data and identity:** With GDPR mentioned in chapter 1.1, Blockchain has the potential to prevent companies from "getting a hold of" people's personal data, and instead put people in control of their own personal data. This creates a sense of security and protection of identity for people, especially with the implementation of identity protecting Blockchain technology.<sup>11</sup> Identity authentication and secure access will be much more granular, flexible, and oriented to real-time demand, than what is currently possible.<sup>33</sup>

**Health care:** Transaction of medical records is a perfect example of data being transmitted that must be protected.<sup>11</sup> Health care industries are showing interest in the potential of Blockchain, due to inefficient and outdated practices to keep patient identities and information safe.<sup>11</sup>

**Media Business:** Blockchain can make music available online, secure, yet convenient to access on the web. It has the potential to change the way the music business deals with royalty costs.<sup>11</sup> An example of this is Imogen Heap, who made music history by releasing her single on the Blockchain music sharing platform Ujo.<sup>11</sup>

**Democracy:** Blockchain can bring financial infrastructure to people who have no access to it (without banks), and has the potential to eliminate the issue of voter fraud. In a Blockchain system, votes cannot be faked. It prevents the anonymity of voters, which protect that data from misuse on the part of the government, while ensuring the legitimacy of the voter's identity through the verification system.<sup>11</sup>



**Insurance:** With the 24-availability of Blockchain technology, you could get insurance on the weekends, even after company hours. The need to resort to insurance companies altogether may be obsolete for some industries. Rideshare drivers can pool their money and utilize smart contract technology to insure one another. This eliminates the need for insurance companies altogether, since the identities of the borrowers are already certified and there is no need for an insurance company.<sup>11</sup>

**Manufacturing:** 3D Printing can be risky in terms of transferring data. This applies to other goods as well. Particularly for smaller companies, the task of protecting the IP of their products is highly challenging when they also are trying to operate on a platform to sell their products. Using Blockchain, people who hold the rights on their creations have a platform to store meta-data on actual substances, thereby ensuring the safety of their products.<sup>11</sup>

**Education:** One proposition is that education can be made into a trackable resource, recorded in your ledger account and qualified in units called "Edu-blocks". One such ledger of education can be used to track people down with the right qualifications. Education is an institution plagued by arbitrary hierarchies, and Blockchain technology could in theory be used to conceive completely new models for restructuring society.<sup>11</sup>

### 3.2.2 Tangible assets

Tangible assets entail physical-world hard assets like a home, car, bicycle, or computer.

**Real Estate:** Blockchain can revolutionize the function of the real estate market by making contracts, deeds and titles more secure and traceable than ever before. With an updated record distributed across

multiple platforms, the risk of this loss is avoided and can be better maintained. Not only that, but the transactions can occur more quickly, which will have an impact on the practice of trading property as an asset.<sup>11</sup>

**Distributing food and drink:** Using E.Coli contaminating vegetables as an example, Blockchain could be utilized to minimize such a danger by creating a more effective tracking system for these products. One unnamed start-up is already working on this.<sup>11</sup>

**Tracking down black market goods:** Blockchain technology can be utilized to form a registry that would allow users to trace the ownership of an item to determine whether they are of illegal or false provenance. That way we will know if a diamond is a blood diamonds or a weapon is made with 3D printers. One unnamed start-up is already working on this.<sup>11</sup>

## **4 Methodology**

The following chapter addresses the methodology of this case study. First, an explanation of the literature search process will be presented, including arguments for the chosen search methods. Further, the method used for processing and analyzing the literature will be explained in detail, including the selection process of articles and the literature review process. After which, the method of obtaining case sensitive information will be presented. Lastly, the methodological limitations will be discussed.

### **4.1 Literature search process**

The literature search process was conducted using, an online database, published books, and conceptual articles online.

#### **4.1.1 Academic paper search in online database**

The aim of using this search method was to find reliable literature on Blockchain technology, KYC processes in banks, and process innovation, in order to try and determine a relation between them. Academic papers provide an in-dept fact-based analysis of the concerning topic which is always reliable and trustworthy. For this, Oria was used. Oria is a common portal to all the material found at most Norwegian academic and research libraries.<sup>34</sup> This means that Oria would function as a collective database of all the other databases, as articles from other databases would appear in the search results. Oria has the functionality of selecting search by "title", "abstract" or both. These sorting options were chosen as they most often include the main focus and scope of the articles. Accordingly, the literature review

would reveal articles that have a relevant and applicable research focus for this study.

**4.1.2    Conceptual article and financial reports search**

Due to the young age of Blockchain technology, the research available was mostly books published by Blockchain enthusiasts (with scientific or business backgrounds). These were all mostly similar in concept as they appealed to the a Blockchain newcomer and opted for a "what is block-chain" theme. In order to attain the latest most updated information about the technology, conceptual articles written by technology firms/start-ups, banks, consultancy firms, technology magazines and websites became necessary to consider. Here, only prominent and well known names that are considered trustworthy were considered. It became more and more evident that this is where the "inside information" were to be found due to current first-mover/quick follower strategies in the market.

Firm	Report/Article
Deloitte	: Blockchain applications in ranking
Goldman & Sachs	: Global investment research.
PWC	: Blockchain info-graphic
Nordea	: Blockchain
DNB	: Project related information
Oracle	: KYC
Financial Times	: Blockchain
EU GDPR Portal	: GDPR FAQs and Key changes

**Table 3:** Example of corporate reports and conceptual articles.

**4.1.3    Published books**

Relevant published books found on Oria were used to define terminology and conceptual background. Most of the books used were written by experts in the field of cryptocurrency and DLT.

Author	Book
Thomas H. Davenport	: Process innovation
Chris Skinner	: Digital Bank
Andreas M. Antonopoulos	: The Internet of Money
David Hamme	: Customer Focused Process Innovation
Jeff Reed	: Financial Technology
O'Sullivan & Dooley	: Applying innovation
Curry, Flett, & Hollingsworth	: Managing Information and Systems

**Table 4:** Example of books used.

## 4.2 Processing and selecting the literature

Some criteria were set in order to decide which articles to discard and which articles to keep for the literature review. The aim of this process was to end up with a sample of relevant articles to be reviewed in more detail. The academic papers based on empirical studies (predominantly on process innovation, digital banking, and Blockchain) were used to create the backdrop for the theory mentioned in this study, as well as factual confirmations and affirmations to this study, while the conceptual articles were used as insight on Blockchain technology, as they were the most updated and/or relevant and informative regarding the topic.

## 4.3 DNB

All necessary information regarding Blockchain in KYC were attained from DNB in confidence. This was accomplished through face to face meetings, phone conversations, as well as e-mail correspondence. Due to changes in contact person as well as contact with multiple people through multiple channels, interviewing one person (or more) was unlikely (also affected by tight schedules and summer vacations). In addition due to the developing

nature of Blockchain, some of the attained information became irrelevant for this study in the end.

## **4.4 Methodological Limitations**

This literature review has certain limitations to its methodology. As the literature search was highly dependent on keywords when performing the literature search, the struggle to define keywords accurately identifying Blockchain related literature became apparent. As this the technology is quite young, and few successful projects have been launched, the majority of the literature found on Blockchain were conceptual articles. Only a few empirical studies were found, but turned out to be irrelevant for this study. Blockchain is in its peek year when it comes to early development and testing stages of pilot projects. This is why the information available when researching for this thesis in December 2016 rapidly changed each month (even every week) that went on, heavily affecting writing this case analysis. Even information attained in June-August 2017 were included in the thesis because the development of KYC projects had changed. Thus, time-sensitivity was a major factor when researching for this thesis. Subsequently the frequency and method of research had to adapt to the rapid development of Blockchain technology around the world.

## 5 Case Analysis

Studies have shown that at global level the potential savings for centralized solutions are in the magnitude of \$400-800 million per year for KYC related processing.<sup>7</sup> Deloitte<sup>35</sup> lists several positive outcomes with the use of Blockchain technology in KYC processes. The use of a distributed ledger system in KYC processes

- can automatize processes and thus reduce compliance errors.
- would remove the duplication of effort in carrying out KYC checks.
- enable encrypted updates to client details to be distributed to all banks (authorized access to their data) in near real-time.
- would provide a historical record of all documents shared and compliance activities undertaken for each client, which could be used to provide evidence that a bank has acted in accordance with the requirements.
- can be of use in identifying entities attempting to create fraudulent histories.
- can help spot irregularities or foul play - directly targeting criminal activity by analyzing the data within it.
- can be used to cement real-world identities to cryptographic identities in the database.
- gives the ability to scan customer documents and identity information and then generate private and public keys to seal them before the data is encrypted and sent to the blockchain.<sup>35</sup>

Goldman & Sachs estimate that proper KYC due diligence can cost \$15000-\$50000 per client. In addition to such financial burden, KYC requests can also delay transactions, taking 30 to 50 days to complete.<sup>26</sup> While annual compliance costs are high, there are also large penalties for failing to fol-

low KYC guidelines properly. With KYC processes on a blockchain, cost like these can be severely reduced. In fact, the Heatwave project estimated a Nordic savings potential of 20-40 million euros per year for DLT solutions and market harmonization. This was based on the participating 5 banks, 2000 large corporate customers and all-in costs such as operations, technology, administration etc.<sup>7</sup> Other benefits expected from this project were efficiency gains on customer side, followed by customer experience improvements. Transparency with the customer in control, and driving regulatory harmonization.<sup>7</sup> SWIFT also recently established its KYC Registry with 1125 member banks sharing KYC documentation (amounts to only 16% of the 7000 banks in their network).<sup>35</sup>

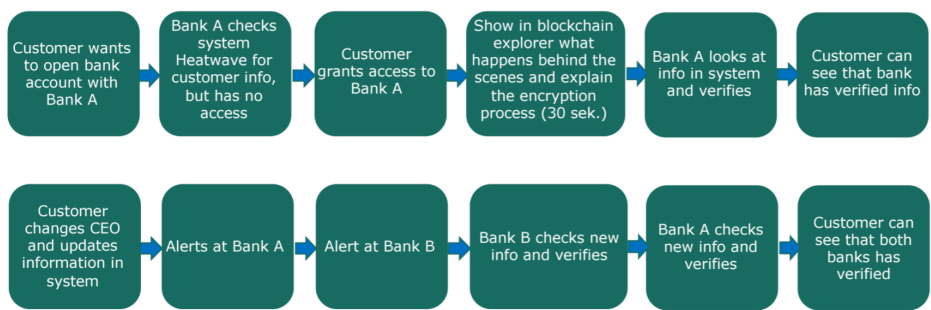


# 5.1 Project Heatwave

Project Heatwave’s vision was to offer an improved customer experience and efficient KYC processes in the financial sector starting in the corporate space, by reducing (removing) existing KYC processing duplicated among all customers and all banks, which causes inefficiencies and bad will among customers.<sup>7</sup> The hypothesis of the project was stated as follows: Will distributed ledger technology as a solution for sharing and processing KYC-relevant information

- 1. allow clients to gain control over their own data?
- 2. gather only one copy of the data?
- 3. increase transparency into to the process while saving time?<sup>7</sup>

## 5.1.1 How the system works



**Figure 5.1:** The systematic process of Project Heatwave.<sup>7</sup>

Figure 5.2 shows the Heatwave system which has two interfaces, one for the bank (upper left) and one for the customer (upper right). The bank can see received notifications (1), and they can also see how many customers have shared their data with them(2). The customer has access to their own basic information(3), and KYC files can be uploaded in the customer interface. The number of banks that has been authorized to use the customer’s data is also listed here (5), along with banks that have signed the customer’s KYC

and verified them as a client. After verification the banks will have access to the customer’s basic information, and KYC documents. If any changes happens from the customer’s side, the bank will receive a notification (2).

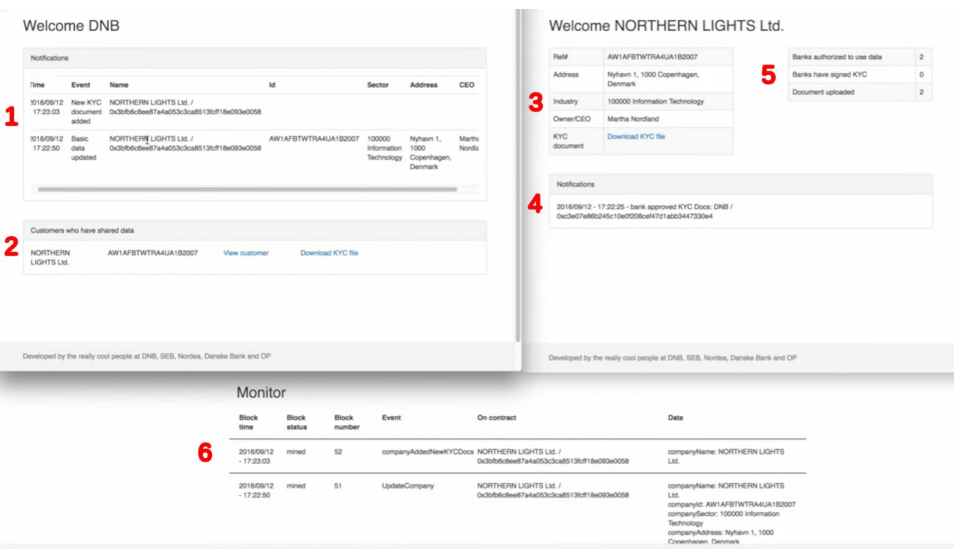


Figure 5.2: Graphics of the system.?

Figure 5.2 shows a blockchain monitor (6) for the purpose of demonstration in order to see what actually happens behind the scenes in the blockchain. In this example Northern Lights Ltd. (NLL) is the customer, and DNB is the bank. NLL would like to become a client of DNB and open an account. For this to happen, DNB has to perform the KYC process on NLL. DNB can access the system and see if they have access to NLL’s information. If not, NLL has to grant access. The blockchain monitor then will show that a new block has been mined (6) which is the new relationship between NLL and DNB. If DNB refreshes their system, they can now see a new customer (2) that would like to share their data. Here, they can see the details of the customer, download document that the customer has updated to prove their identity, and they can improve the KYC data. NLL will then receive a notification (4) that the bank has approved its data and ready for them to

become a client at the bank. They can also edit the data, and all banks with access to that customer's data will be updated.

## **5.2 Findings and Outcomes**

Using the IPO framework of business process change, the outcomes of Project Heatwave can be categorized in three categories: business outcomes, process outcomes (what they learned of the process), and technological outcomes.

### **5.2.1 Business**

From the business aspect, Project Heatwave showed that if they focus on the customer experience, benefits such as cost reduction and efficiency would follow. In addition, if a base infrastructure is successfully established, there are multiple future value points to pay attention to, these would be: increased trust between banks, customer identity service, and a digital tie into other information providers (e.g. government ID scheme to eliminate paper copies). Furthermore, the need for developing a common standard for customer data collection became evident. This would provide a common infrastructure in order to drive efficiency and standardization. On the other hand, they found it difficult to isolate the benefits of a DLT solution vs. today's traditional KYC solution, which means necessary measuring factors must be put in place. Also, only with a larger number of bank candidates, a quantitative business case will be possible (only 5 banks participating in Project Heatwave).<sup>36</sup>

### **5.2.2 Process**

From the process aspect they realized that building a new business model with a industry-new technology will be a complicated and difficult task,

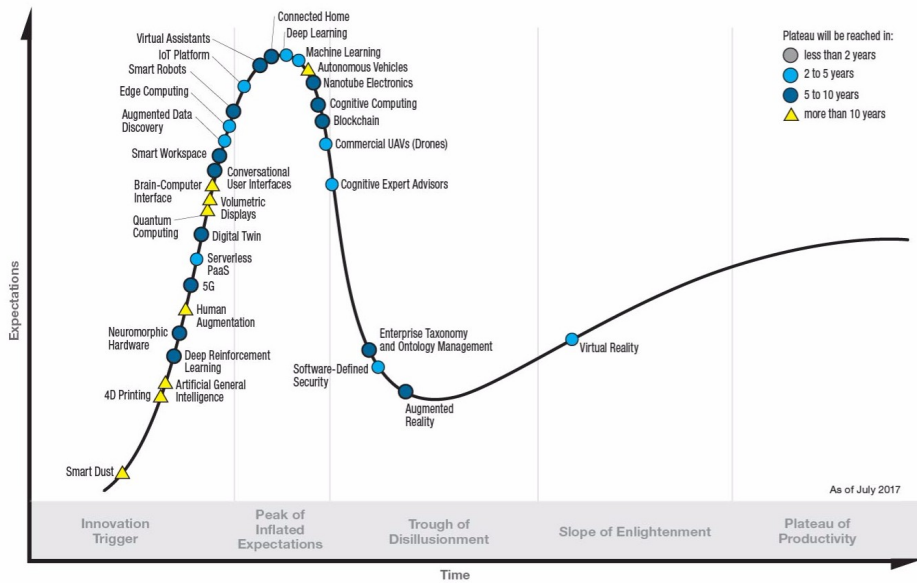
which further proved that there is much more to learn and many unanswered questions to explore. There was common consensus on the use of experimental approaches in dealing with uncertainty, thereby allowing for pivots. Practical factors such as meeting early and often, and face to face, would help increase human interaction and further develop close teamwork (subsequently, team workshops in Stockholm, Copenhagen, London, and Helsinki were held). Transition from experiment mode to product development seems difficult to achieve without a separate team to take it forward. In addition, balanced engagement between the core team and outside experts are strongly required (e.g. legal, business, customers, audits, etc.).<sup>36</sup>

### **5.2.3 Technology**

For such projects, smart contracts and/or distributed ledger can be used for: messaging, automated execution of logic, transparency of code to drive standardization, and audit trail of user access. Cryptography will provide trust and security between clients and sharing of data with banks. Also, the build and maintenance of participant registry (key registry) is critical and they learned that ongoing management of keys will be hard to do, but possible. In addition, minimizing the volume of data (especially binary data) stored on the blockchain is necessary.<sup>36</sup>

## **5.3 Challenges**

The biggest challenge in this case was, and still is convincing board members and stakeholders that 'banking on' Blockchain technology is the advantageous thing to do. Gartner's Hype Cycle has been used both as a fear factor, but also as a motivational tool. This is a graph of a common pattern that arises with each new technology or innovation. Hype Cycles are created every year in various domains as a way for clients to track technology maturity and future potential. Figure 5.3 shows the Hype Cycle for 2017,



**Figure 5.3:** Gartner's Hype Cycle of 2017.<sup>9</sup>

we see that the five phases in the Hype Cycle are: Technology trigger, Peak of inflated expectations, Trough of disillusionment, Slope of enlightenment, and Plateau of productivity.<sup>37</sup>

The figure shows that in 5-10 years Blockchain technology will reach the plateau of productivity phase. At the moment we see that Blockchain is placed barely within the peak of inflated expectations phase, and seems to slowly move down the slope towards the trough of disillusionment phase. The reason for this is that development and testing of use cases for Blockchain technology mainly is conducted behind closed doors. In other words, there is a suspense over who will peek as a first-mover, and who will quickly follow as a fast follower. Regardless, we will most likely see larger projects rolled out already by next year.<sup>7</sup>



# **6 Evaluation**

## **6.1 Choosing Blockchain as a thesis topic**

Given the rapid pace of development with Blockchain, there was a need to constantly monitor and assess new articles, published projects as well as start-ups formed (in 2017 alone) in order to stay ahead of the curve. It was a challenge to maintain an innovative thesis perspective, as what I considered innovative quickly turned out to already have been tested out by industry giants behind closed doors. Evidently I settled with the fact that this thesis might end up being a report on real-life progress, rather than a paper on innovative possibilities. Subsequently the structure of the thesis fluently changed and adapted to the information available from DNB, the tech-industry and the financial industry.

## **6.2 Project Heatwave developments during thesis writing**

Project Heatwave was initially intended to be used as the main case for the case analysis. This project was a Nordic collaboration between SEB, Nordea, DNB, OP and Danske Bank.<sup>7</sup> The project was cancelled as the Swedish government wanted to start to incorporate Blockchain technology, and the Swedish banks therefore opted out of the project due to priorities. Even though the project moved beyond test status, I decided to keep it as an industry specific example rather than the main scope for the case analysis because new data/customer testing data would not be available. In addition, results from initial testings were also unavailable as time-constraints

prevented gaining access to the relevant data within the thesis deadline.



## **7 Conclusion and Future Research**

This thesis investigated the possibilities of using Blockchain technology as an enabler for process change in KYC processes in banks. The KYC process in DNB was evaluated on a non-technical basis. The information gathered from DNB showed positive attitudes towards such a concept, and it became clear that there is a strong desire and great need of decentralization of KYC processes. The presence of a technical evaluation would obviously have yielded useful and insightful results, unfortunately, due to time-constraints and corporate delays, this was unfortunately not achievable. Going back to the original research question of this thesis, the results of the non-technical evaluation highly indicate that Blockchain can be a powerful tool for process innovation in KYC processes in banks. As long as the banks invests in enough resources (people, time, and technology), it is most definitely successfully achievable.

### **7.1 Future Research**

Exploring further possibilities within KYC with Blockchain is necessary, especially because Blockchain technology is constantly evolving and developed in different industries and governments around the world. The possibilities for further research within Blockchain as a topic are therefore endless. KYC processes in the future will most definitely run on blockchains, but beyond that is difficult to predict, mainly of the unpredictable nature of Blockchain technology. In the early 90s there were no certainty of what the Internet as we know it today eventually would become. Decentralized ledgers opens up endless possibilities for everything from small businesses to government structures. This thesis is written right in the middle

of the excitement for the *potential* of this technology, thus speculations and predictions can only be left to endless imagination.

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