



**BSc í viðskiptafræði með tölvunarfræði sem aukagrein**

Blockchain and the development of payment  
intermediation in Iceland

A scenario analysis

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## **Abstract**

The aim of this study was to research what effect blockchain might have on payment intermediation in Iceland. Deep interviews were conducted with various experts inside the financial sector. Interviewees were technologically driven, holding key positions at companies within payment intermediation or associated areas. Results were presented with the application of scenario analysis. Four scenarios were staged confined by two dimensions. These dimensions were the possibility of substitute technology and industry rivalry. In the future, the potential for blockchain to influence payment intermediation in Iceland is evident. Rules and regulations are evolving, new entrants have emerged along with changes in the banking sector. The main conclusion is that payment intermediation is not considered to be a major hurdle in Iceland. Payment and interbank systems have recently been renewed. However, the Central Bank has shown interest in Central Bank Digital Currencies and new entrants might take advantage of the technology. Blockchain can be utilized in minimizing the effort of reconciliation within payments and improving the inefficient cross-border payments. As the technology still holds certain limitations, it will prove to be a cost-benefit analysis between current systems and blockchain systems.

*Keywords:* information technology, blockchain, payment intermediation

## **Preface**

This thesis is a final project in BSc degree in Business Administration with Computer Science as a minor at Reykjavík University. This thesis applies to 12 ECTS. The authors are Arnar Freyr Guðmundsson and Björn Þorláksson. We would like to thank our instructor Dr. Páll Melsted Ríkharðsson for his excellent guidance and all the help throughout the process. His support was essential and we cannot thank him enough. We would also like to thank Kristján Ingi Mikaelsson for sharing his knowledge and all his help. Finally, we want to thank our friends and family for the support.

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# 1. Introduction

In the ever-evolving world of information technology there has been exponential growth in recent years. Alongside that growth, product quality has been increasing with a decreasing price, computers are more efficient than ever before and the cost of computational storage has decreased (Roser & Ritchie, 2020). Multiple tools that throughout the years were only accessible for few are now available for the masses. Private computers, the internet of things and smartphones are connecting people to technology. It has been said that technological evolution is the foundation for economic growth (Jimenez, 2019). A statement which is certainly debatable however in most cases the benefits of technological improvements outweigh the costs.

There are few sectors that have been more impacted by technology advancements than the financial sector. The financial sector, ranging from firms to institutions providing service to various customers has been affected in every way. Computerization and the adoption of the internet has revolutionized the speed and process of systems and information. Processes are moving away from human interactions to humans interacting with computers; creating more automation (Klein, Saltzman, Duggal, 2003). Trading stocks and bonds today is heavily influenced by algorithms that follow human instructions on when to buy and sell. JP Morgan estimated in 2017 that only 10% of trading involves human to human interaction (Chang, 2017). Observing the banking sector, technology reformed how one applies for a mortgage, options of payment and overview of finances. Web-based applications are paving the way for customers to handle their professional and personal finances in a decentralized manner, away from brick and mortar bank branches. Examining places where online banking is considered advanced, banks seem to experience lower costs and higher revenues. Efficiency measures like overhead ratios and net interest margins are often used to evaluate risks. Lower overhead ratios and lower net interest margins seem to be adherent to emphasizing online banking, resulting in lower risk (Simpson, 2002).

Payment intermediation in its simplest form is moving funds from payer to receiver. This can be done either with physical funds or electronically when an intermediary moves funds. Despite the biggest part of payment intermediation is through electronic payments (Seðlabanki Íslands, 2013), the demand for physical funds rose after the collapse of the Icelandic banks in 2008 and has held its demand ever since (Seðlabanki Íslands, 2015). Payment intermediation in Iceland has been developing in recent years. The economy along with customers in Iceland, are relying

more on digital solutions. Innovations in technology, greater speed and simplicity, lower costs and an increase in knowledge are factors contributing to the development (Seðlabanki Íslands, 2019).

In regards of progressive technologies, the buzzwords of recent times blockchain and Bitcoin have gained widespread recognition. Blockchain is the underlying technology of Bitcoin and will be the focus here. Blockchain technology originates in ideas presented in the early 80s but it wasn't really introduced to the world until 2007 when Bitcoin arrived (de Jong, 2015). Common characteristics being its immutability, as it is in a way irreversible. Trust is an eternal condition and complete transparency is in place. The network is made up of blocks that are connected with unique strings and nodes that validate each entry (Crosby, Nachiappan, Pattanayak, Verma, Kalvanaraman, 2016). There are certain key benefits that characterize the technology. Time saving as the transaction does not require a complex verification. Cost savings following the need of less oversight, removal of intermediaries and repetition of work is reduced (Gupta, 2020). As with every other technological breakthrough, blockchain has its drawbacks and limitations. Thousands of transactions go through payment and stock exchange systems every second. An open blockchain that functions by the validation of all participants might operate at a slower rate than the systems mentioned above. A blockchain is difficult to govern as the system is highly decentralized and depends on its users' validation. Therefore, sectors with complex regulations might be a barrier for the technology (Aste, Tasca, Di Matteo, 2017).

As reported by Valfells and Egilsson (2017) central banks should have an eye on the new technology. There are a few benefits that this technology could lead to. Elimination of cash, elimination of tax avoidance along with enabling central bank money in digital form. Regarding payment systems it could increase efficiency, lower costs and limit the efforts of reconciliation. The technology can prove to be a credit mechanism between two parties exchanging assets; enabling the assets when requirements are met (Guo & Liang, 2016)

Along with the rapid development in payment intermediation and the emergence of regulations like PSD2 there are strong implications that blockchain might be an influential factor. Systems that were inaccessible before having opened up which opens the door for further evolution. Improving efficiency, reducing cost and time accompanied with naturally provided trust seem viable characteristics although it is still unclear who will reap the benefits of blockchain in Iceland. As with every other emerging technology, one should wonder where blockchain will make its way. The financial sector is often mentioned in that regard or in the words of PwC: "First,

blockchain could make the financial services industry's infrastructure much less expensive. And second, the list of potential uses is almost limitless, from financial transactions to automated contractual agreements and more“ (PwC, 2020, p. 13).

This leads us to the research question we want to explore in this thesis. With the use of qualitative research and deep interviews we aim to answer the following research question using scenario analysis:

*What effects could blockchain have on payment intermediation in Iceland?*

This research is important as we are arguably standing at a turning point. A turning point as entities are in abundance to explore the emerging technology and how it might improve their processes. By carrying out interviews that include experts and persons holding high order positions in the sector, a detailed analysis of how the technology might emerge is presented. This research is important for academics as few have focused on this issue and there are implications it needs to be researched further. It might also prove as guidance to practitioners as the scenarios can be useful for strategic planning. Combining scenario analysis with expert interviews is a novel approach on this issue in Iceland.

## **2. Blockchain**

Blockchain in its most simplistic definition is a shared and immutable ledger (Gupta, 2020). For all sorts of transactions, some have even gone to the length of saying that blockchain can revolutionize them in a similar way like the Internet impacted the handling of information. Transactions take place with assets. Assets can be either tangible or intangible, physical or non-physical. Theoretically every transaction including the exchange of assets can be implemented with blockchain technology (Gupta, 2020).

### **2.1 History and origins**

A person under the identity of Satoshi Nakamoto released a paper in 2008 titled “Bitcoin: A Peer-To-Peer Electronic Cash System”. The paper outlined an online financial system, paving the way for payments to be sent between participants without the interference of financial institutions. A concept that today is widely known as “cryptocurrencies” (Crosby et al., 2016). Bitcoin became the first decentralized solution to enable online exchange of currency. The system had certain innovative features that utilized blockchain technology. All transactions are public and independently validated by participants. Each transaction is transmitted to the network and added to a block. In order to be added to a block the transaction must be verified and cryptographically secure. The blocks are added in sequential order and connected with unique strings (Aste et al., 2017). In recent years Bitcoin has gained widespread recognition and as of April 2020, a total of nearly 518 million transactions have been completed. At the same time, the total number of mined Bitcoins amounted to 18.3 million with a market price of approximately \$7,000 each (Blockchain, 2020). The concepts Bitcoin and blockchain are deeply linked but not inseparable. Bitcoin is merely a function implemented through blockchain. Whilst Bitcoin is the most popular and widespread blockchain application, blockchain has found its place in various industries (Crosby et al., 2016); industries such as data management, data verification and the financial sector (Zīle & Strazdiņa, 2018).

The core principles of blockchain originate in the idea of shifting from trusting people to trusting computers (Aste et al., 2017). As de Jong (2015) states the “block” part was birthed with the “Merkle Tree” designed by Ralph Merkle in 1979. Two years later in 1981, the “chain” part was founded by Leslie Lamport (de Jong, 2015). The Merkle Tree was a function providing a

digital signature. By using a conventional encryption function or a one-way function, Ralph succeeded in what others had failed to do and provided a one-way function without excessive computational costs (Merkle, 1988).

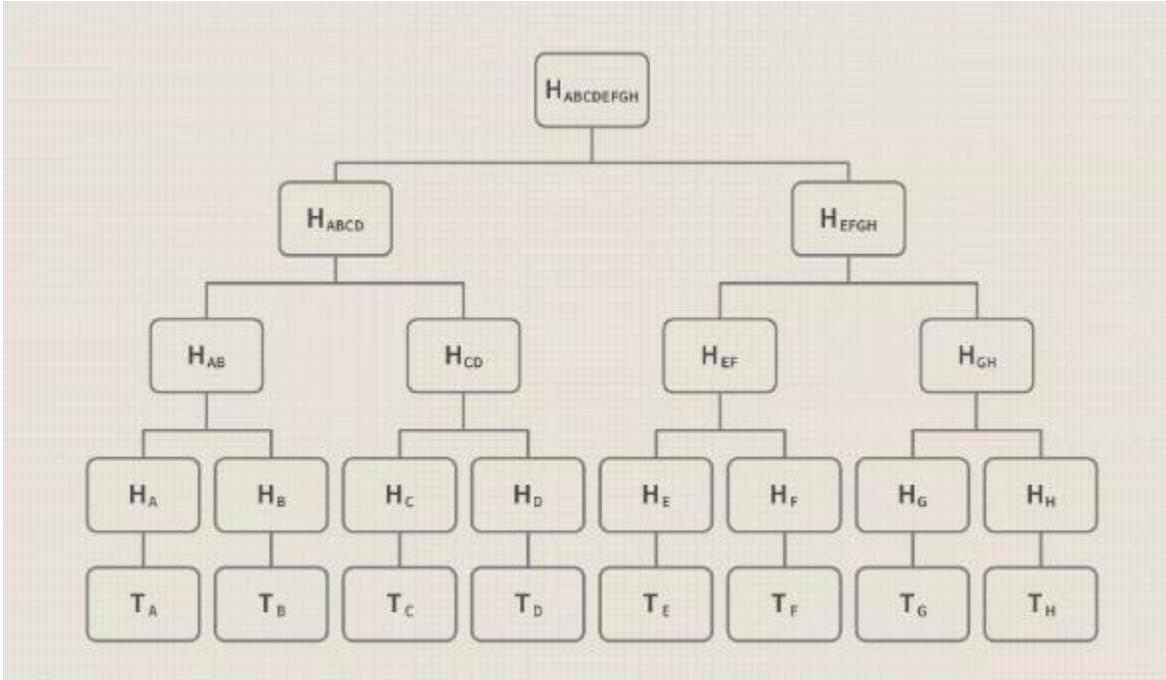


Figure 1: Merkle Tree (Frankenfield, 2020).

The tree is represented by hashes and transactions. Each transaction is hashed and given a unique identifier. A transaction then spirals up the tree and is concentrated with the transaction next of it, creating a new unique hash string. This process repeats itself until the transactions combine into one hash, resulting in a single block (Frankenfield, 2020). Leslie Lamport introduced the Lamport signature (Lamport, 1979). A Lamport signature also utilizes a one-way function. Outcome of the function is a unique digital signature recognized and confirmable by any participant. This signature contains no private information and it cannot be forged (Lamport, 1979). The tree provided by Merkle and the signature provided by Lamport make up a chain of blocks. In each block multiple transactions and hashes are concentrated into a single hash, similar to the Merkle tree pictured above. The blocks are then connected with digital signatures in chronological order. The blockchain in its present picture does not specifically use the functions provided by Merkle and Lamport. However, they were the basis and origins for the technology. Paving the way for improvements and vitally important to grasp the idea of a functioning blockchain.

## **2.2 Characteristics and benefits**

The properties of a distributed ledger network like blockchain might vary with its implementation and means of use. A blockchain can be private, public or permissioned. The separation between those three lie within the access of the ledger. Private systems are closed for access, participants are predetermined and transactions are confined to them. Contrarily, public systems are open for access. The ability to access, maintain, add and validate is open for anyone. Participants can join, take part and quit as they please. In permissioned systems there is a mix of private and public properties, the mix varies with the system's purposes. A permissioned system might include a barrier of entry, limited data flow and maintain in a way a centralized system with the benefits of a decentralized system (Viriyasitavat & Hoonsopon, 2019). As the network varies with its accessibility and centrality there are certain characteristics that designate most blockchains.

### **2.2.1 Consensus**

Among the network there is a general consensus between users. For a transaction to be valid, all users must agree on it (Gupta, 2020). The consensus is a procedure to ensure the sequential order of the chain. Each request, transaction and each piece of information is executed in accurate order (Aste et al., 2017). How consensus is achieved in a blockchain network differs but there are generally three properties considered; safety, liveness and fault tolerance (Viriyasitavat & Hoonsopon, 2019). Safety is a measure of consistency and validity of output between nodes in the network. Liveness is achieved if each good node produces a value in the end. Fault tolerance is marked as the recovery from a failed node. The failure is explained as a node failing to participate or participating erratically (Baliga, 2017). While all three properties are considered important, Fischer, Lynch & Paterson, (1985) concluded that in a consensus application executing asynchronously will only include two of the three properties. All three properties are impossible to guarantee with consensus algorithms in an asynchronous system. Most consensus methods in distributed systems like blockchain emphasize fault tolerance. An application focusing on fault tolerance and safety over liveness results in a ledger where each node will accept the ledger details at any given time. Aiming at fault tolerance and liveness over safety will result in greater availability instead of every node having the same ledger. Common blockchains like Bitcoin and

Ethereum use consensus methods based on fault tolerance and liveness (Viriyasitavat & Hoonsopon, 2019).

### **2.2.2 Origins**

The provenance is clear and undebatable. Users share knowledge of origins and ownership (Gupta, 2020). A transaction includes a timestamp and information making it traceable by each user in the network. The included information varies with the purpose of each network but in most cases includes history to ensure traceability (Viriyasitavat & Hoonsopon, 2019). The ledger is distributed and there is no explicit authority that validates each transaction. Each transaction is validated by the users of the ledger. Users have access to the consensus protocol and enforce it providing a transparent and traceable transaction (Aste et al., 2017). As there is no central authority maintaining information and controlling the ledger, a certain degree of anonymity can be ensured. Users' information in the system is not required to reflect their true identity. A single person can hold several nodes in the system (Viriyasitavat & Hoonsopon, 2019). With cryptographic methods the identity of a transaction and involved participants can be masked (Gupta, 2020).

### **2.2.3 Immutability**

Transactions are immutable. Once a transaction has taken place it cannot be reversed or altered. If the transaction results in an error, a new transaction must be placed and both are visible (Gupta, 2020). Transactions are irreversible due to the use of one-way hash functions, similar to the ones described earlier. The network's consensus also enforces irreversibility. An important result of these procedures is trust. Trust is an eternal condition in the system created by the functions and consensus (Aste et al., 2017).

### **2.2.4 Finality**

Everything is stored in a single and shared ledger. Transactions, participants and information is stored in one place and has a single point of entry, a so-called single source of truth. As described before every participant holds a copy of the single source ledger; it is a shift in ownership of data. Instead of a single entity being responsible for the data similar to traditional business processes, it is shared in a single ledger and maintained by participants (Gupta, 2020).

### **2.2.5 Common benefits**

A network wrapped with previously displayed characteristics comes with certain benefits. A common benefit is time savings. Complex systems handling transactions between multiple groups can lower transaction time from days to minutes. The transaction is free from central authority validation (Gupta, 2020). The network takes advantage of cryptographic functions that provide self-execution, self-enforcement and self-verification creating greater automation than in traditional systems (Aste et al., 2017). As well as saving time the network also reduces cost. With peer to peer interactions that are automatically administrated by users, the removal of intermediaries is evident. Each node has access to the same single source of data eliminating the duplication of effort (Gupta, 2020). A blockchain network provides greater security on two levels. First the execution of a single transaction and second, the system in general. A single transaction is secure on a peer to peer level protecting ownership and validity. The system in general protects its users from manipulation, counterfeiting, forgery and unauthorized access (Drescher, 2017). Integrity is kept intact as the network operates free of logical errors. Greater integrity maintains data coherency and the level of security (Drescher, 2017). Trust is generated by maintaining that integrity as well as immutability. The truth is the truth and is trusted by the mechanisms of the system (Aste et al., 2017). A key benefit in the network is transparency. With a self-maintained open history of transactions that is widely accessible to every node the network operates in a transparent manner (Aste et al., 2017).

### **2.3 Limitations and drawbacks**

Although the network presents several attractive features for various purposes it certainly has had its fair share of debates. A variety of use cases seem to fit the technology while other shed light on its limitations. As identified and described by Drescher (2017) there are certain limitations of the technology:

- Lack of privacy
- The security model
- Limited scalability
- High costs
- Hidden centrality
- Lack of flexibility

- Critical size (Drescher, 2017, p. 206)

### **2.3.1 Technical limitations**

As the validation mechanism of the network requires data to be open access. Details as user information, items being transferred as well as the amount is open to everyone. However, this is a fundamental function of the network as previously described, transactions are validated by participants (Drescher, 2017). For the network to execute transactions and operate accordingly a public and private key is provided. Even if the cryptographic functions used in blockchain are considered among the best, there are no fallback measures if one's private key is compromised (Drescher, 2017). The network focuses on allowing everyone to add to an openly maintained history as well as maintaining it. Methods such as hashing and signing of each block can prove to be inefficient if the network is required to operate at great speed, on a big scale with large throughputs (Drescher, 2017). Even if replacing a solution with a blockchain based one can prove to save money there are trade-offs with computational resources. A similar problem to scalability might occur with computational costs. As the methods to keep a network secure and immutable are considered safe, they might result in high computational costs, computational cycles and physical time (Drescher, 2017).

While maintaining the system, participants with greater computational power can more efficiently validate and solve each block. As a result, they hold more nodes in the system than others that lack the same level of computational power. The process of sustaining the integrity of the system then shifts from many various nodes to the nodes that hold greater computational power. Those nodes prove to be a hidden centrality as they then hold the power of manipulating the system (Drescher, 2017). A similar problem to the centrality, if the system's majority is controlled by ill-mannered nodes, they can execute malicious actions. Integrity of the system depends on well behaved nodes holding the majority of number nodes to prevent attacks (Drescher, 2017).

While the non-technical limitations are:

- Lack of legal acceptance
- Lack of user acceptance (Drescher, 2017, p. 209)

### **2.3.2 Non-technical limitations**

A similar situation can be recognized with the emergence of the internet in the 90s and blockchain nowadays. A disruptive innovation that might transform traditional processes raises legal questions. A system with peer to peer communication involving a constant flow of transactions and transferal of ownership might raise conflicts within the rule of law (Drescher, 2017). Lack of knowledge and education amongst users or customers might result in less acceptance amongst them. With an open debate about the legal aspects of blockchain might reduce interest and cause uncertainty (Drescher, 2017).

## **2.4 Application within payment intermediation**

Blockchain technology is finding its ways in both financial and non-financial sectors (Crosby et al., 2016). In 2019, thirteen blockchain companies acquired a total of \$365 million (PwC, 2020). Although some of these companies may not survive, there are indications that blockchain and public ledger systems will be an essential technical part of financial institutes (PwC, 2020). Next sections will further demonstrate the range of blockchain solutions, platforms and applications that have already been established. Some are on the horizon while others laid the foundation. These examples will be divided into three categories that take on the process of payments by any means, smart contracts, payment systems and exchanging assets.

### **2.4.1 Smart contracts**

Blockchain technology has already found its way in contracting. Smart contracts are a computerized transaction protocol and similar to normal contracts there are terms that are executed (Szabo, 1994). As the finance sector traditionally relies on a third-party institution to validate and verify various transactions; blockchain might automate the process (Crosby et al., 2016). Trading, executing payments and settlements between financial markets and across borders with smart contracts might prove to be a viable solution. As a result, traditional bank functions might shift (Valfells & Egilsson, 2017). Ethereum was introduced in 2015. As with Bitcoin, Ethereum holds a cryptocurrency called Ether. However, Ethereum is fully programmable. Meaning that applications can be deployed on the blockchain and once deployed they will consistently run as programmed. These applications are decentralized, employ the benefits of blockchain and range

from financial apps to simple card games. A well-known use case of Ethereum is the deployment of smart contracts. The contract is a block of code functioning with requirements on Ethereum and holding resources. Curated and maintained by globally distributed developers Ethereum is the largest blockchain community in the world (Ethereum, n.d.). R3 is a company collaboratively founded by over 70 international banks (Valfells & Egilsson, 2017). With over 300 participants, R3 operates on the Corda blockchain (Corda, n.d.). Originally intended to address the requirements of financial institutions, Corda is widely applicable. Various customers from capital markets, digital assets, energy, healthcare and finance successfully deploy and practice smart contracts on the Corda blockchain (Corda, n.d.).

Acknowledging the benefits of smart contracts can be recognized by taking a closer look at crowdfunding. Crowdfunding websites have experienced cases of fraud. Cases where people have put up a crowdfund with some vision but when the goal is reached, they disappear with the money. This problem can be solved using a decentralized way such as Smart contracts. Using requirements, funds are not given until founders meet the requirements. The requirements can be that they must show some proof of progression (Shah, 2017).

#### **2.4.2 Payment systems**

Systems processing cross-border payments today are obligated to work with globally distributed intermediaries. Complications such as different regulations result in reconciliation processes, inefficiency and restrictions (Gupta, 2020). Specializing in cross-border payments and settlements, Ripple is a company that has provided a viable solution. With blockchain technology, Ripple has enabled cross-border payments at a low cost. Taking advantage of the benefits of blockchain, Ripple is a reliable and decentralized solution. Ripple is currently operating with numerous large financial institutions like American Express, MoneyGram, PNC, Santander and SCB (Ripple, n.d.). Along with addressing the problems of traditional cross-border payments, blockchain might prove to be a viable solution to the under- and unbanked. Estimated 1.7 billion people are short of basic financial services. Looking at the key institutions providing payment services a revenue increase of over \$200 billion might be achieved by incorporating the financially excluded individuals. Lower costs, improved efficiency and transparency imply that blockchain might play a crucial role in including the financially debarred (Lichtfous, Yadav, Fratino, 2018).

A collaborative project across the Italian banking industry called Spunta went live in March of 2020. Established by the Italian Banking Association, Spunta is implemented on R3's blockchain platform Corda. Interbank transactions in Italy have been a long-term problem as Spunta is supposed to take on the automation of transactions, minimize the effort of reconciliation and resolve the error prone settlements. Utilizing the blockchain platform the banks are intended to have a joint consensus on each transaction, creating a more efficient and transparent process. A total of thirty-two bank entities were the early adopters with the entire Italian banking sector expected to take part by the end of 2020 (R3, 2020a).

### **2.4.3 Exchanging assets**

Besides smart contracts, blockchain has been utilized in other ways in exchanging assets. Exchanging currencies, stock and bond issuing and trade finance has been made available through blockchain platforms (Zīle & Strazdiņa, 2018).

Founded by the MIT professor Silvio Michali, Algorand is the first proof-of-stake blockchain platform. Algorand is developed by experts in cryptography, economics, researchers and mathematicians. Taking on the technological limitations of previous blockchain platforms, Algorand is emphasizing decentralization, scalability and trust. A fast throughput is established as well as the first pure proof-of-stake consensus. Consensus is achieved by users and corresponds to their stake in the system. Algorand can be used for a wide range of decentralized applications. Asset tokenization, 3rd party asset issuance, resolving trades and complex settlements are available amongst others on Algorand (Algorand, n.d.).

Founded in Iceland, Monerium is permitted to act as an Electronic Money Institution. By operating on the blockchain platform Monerium allows customers to build financial applications using electronic fiat currency. Monerium is blockchain agnostic meaning that it operates on the platform that the market chooses (Monerium, 2020). Fiat currency is issued by governments. It is not held in proportion to physical objects such as gold or silver. The value of each is determined by numerous factors such as supply and demand as well as the solidity of the supplying government (Chen, 2020). Monerium operates at the ratio 1:1. A single piece of fiat currency is handed over and instead one will receive a single piece of electronic fiat currency through blockchain. Monerium then handles that single piece of fiat currency according to law and in Iceland it is placed in government bonds. The person holding the electronic fiat currency owns that object

irrelevant to the financial structure of the company that provided it. By law companies operating as an Electronic Money Institution are obliged to stake their own equity as well. The person receiving the electronic money is then insured for the original amount that he handed over (Egilsson, 2019).

Recently a partnership was announced between Nasdaq and R3. Nasdaq is a long-established institution that provides various infrastructure technology and services. By operating on the Corda blockchain provided by R3, Nasdaq enables a full lifecycle of digital assets through blockchain. Participants in capital markets can now issue, trade, settle and determine ownership of digital assets on Corda (R3, 2020b).

### **3. Payment intermediation in Iceland**

#### **3.1 The Central Bank of Iceland and payment intermediation**

According to law the Central Bank (*Lög um Seðlabanka Íslands* nr. 92/2019) has certain roles to fulfill. For example, to help with an active and safe financial system including payment systems inside and outside of the country (Seðlabanki Íslands, 2018a).

The Central Bank oversees a systematically important financial infrastructure. Their aim is to help with safety, activity and feasibility of the infrastructure; resulting in financial stability. Regarding interbank settlements, the Central Bank has a direct approach to all settlements. The Central Bank owns and operates the payment systems but Reiknistofa Bankanna services technical operations of the systems. With the direct approach of the Central Bank it increases efficiency and lower counterparty risk. When it comes to issuing banknotes, the Central Bank is the only one permitted by law to issue them (Seðlabanki Íslands, 2018a).

With the development of payment intermediation in recent years as it is moving more into electronic payments, the Central Bank must have an overview of the risks that this development can have. These risks can vary from cyber-attacks to natural disasters. They have plans to secure continuous operations and preparedness in case any serious risks occur (Seðlabanki Íslands, 2018a). In 2019, the Central Bank founded Greiðsluráð which is a consultative forum. It was founded following changes in technology and regulation. It takes care of strategic planning regarding payment intermediation and financial infrastructure (Seðlabanki Íslands, n.d.).

#### **3.2 Reiknistofa Bankanna**

Reiknistofa Bankanna (here after RB) was founded in 1973 and began to operate in 1974. It had been a work in progress since 1970 to establish a service center for the Icelandic financial sector. Since it was founded it has developed software services for financial institutions and is an important backbone in the sector (Reiknistofa Bankanna, n.d.-b). In 2011 RB was changed to a corporation. The Central Bank, previously a part owner sold its part in exchange for ownership of the systems (Seðlabanki Íslands, 2019).

RB is an IT service center that services the Icelandic financial market. RB can be split into three services, that is core banking solutions, hosting and managed services and services and consulting. RB's core banking solutions are divided into payment solutions, deposit and loan

solutions and risk management and supervision. Most financial institutions in Iceland use this solution including commercial banks, savings banks and Seðlabanki Íslands (Reiknistofa Bankanna, n.d.-a). The aim with the cooperation between the banks and RB is to increase economies of scale but also to improve the service to customers (Blöndal, Rúnarsson, Ögmundsdóttir, Gunnarsdóttir, 2018).

### **3.3 Interbank settlements and payment systems**

Interbank settlements are a part of RB's core banking solutions. These settlements can be split into retail netting system (small payments) and real-time gross settlement system (big payments) (Reiknistofa Bankanna, n.d.-a). As stated before, these systems are owned by Seðlabanki Íslands and the retail netting system is run through Greiðsluveitan but RB on the other hand takes care of the software service. There is a difference between these two systems. Retail netting system covers transactions that are under 10 million ISK (Seðlabanki Íslands, n.d.). An example of usage would be whenever two individuals in separate banks make a transaction. Transactions between financial institutions are executed by the system while internal transactions are handled within each institution. The real-time gross settlement system covers transactions that are over 10 million ISK. There are eight financial institutions that have access to the retail netting system and the system takes orders from them. This system was established 2001 and as the name implies, the payment instructions are booked immediately in the accounts of the payer, the recipient and the relevant financial institution. This system is a vital part of the Icelandic financial sector and is used in many different aspects. An example of transactions that are settled with RTGS are transactions from the Central Bank and deposit institutions, transactions in the interbank markets and for foreign currencies (Seðlabanki Íslands, n.d.).

### **3.4 Commercial banks and renewed payment systems**

Similar to other participants in the payment intermediation, the commercial banks have been facing changes in recent years. Commercial banks provide payment services such as payments in and out of accounts, loans, cash withdrawals, transfers and payments with credit and debit cards (Landsbankinn, n.d.). As others they have shifted their attention to digital solutions and offer their services through mobile apps and web applications.

In 2015, RB settled with the software solution company Sopra Banking Software about renewing the payment systems (Reiknistofa Bankanna, n.d.-b). As the old systems were built in-house these new systems were long overdue. The new systems are more standardized than the old ones, the aim was to make the technology environment more flexible and safer along with increasing cost efficiency. Landsbankinn was the first bank that implemented the new systems and it was a complex process according to the Central Bank (2018a). The implementation came with unforeseen problems that influenced the system. These problems can be traced to communication errors between the new system and the old system (Seðlabanki Íslands, 2018a). Following Landsbankinn, Íslandsbanki started the same process in implementing the new systems. The implementation in Íslandsbanki didn't come with as many problems as it did with Landsbankinn though the implementation itself was way more complex than with Landsbankinn (Seðlabanki Íslands, 2019). In 2018 RB got to an agreement with Arion Banki about implementing the new system in their operations and the implementation itself is estimated to start in 2020 (Seðlabanki Íslands, 2019). As Reiknistofa Bankanna (2017) states, these systems will simplify and update the technology environment of the banks, it is cheaper in operation and more flexible than the old systems. These systems will help share software solutions inside the financial sector.

### **3.5 Fintech and PSD2**

Financial technology or fintech is described as “Technologically enabled innovation that could result in new business models, applications, processes, or products with associated material effect on financial markets and institutions and the provision of financial services” (BIS, 2018, p. 8). Fintech could have a large effect on financial markets in Iceland but how fast these effects will appear lies in the pace of technological development and the reaction from consumers (Blöndal et al., 2018). Looking specifically at Iceland, banks bear high fixed costs and are heavily regulated. These factors might be beneficial to fintech companies as they might offer similar services but not as restricted (Blöndal et al., 2018).

In recent years there has been a growth in payment solutions. Many fintech companies have been founded here in Iceland. Some of them have launched apps that process payments for example Aur and Kass but until now all the solutions are built upon regular payment card systems. However, if looking abroad these solutions are moving more into being built on their own systems without connection to regular banks (Seðlabanki Íslands, 2018b).

This increase in entrants on the market can be traced to new regulation regarding payment services, PSD2. PSD2 is the second payment services directive published by the European Union. With these new regulations, new licensed service providers will gain access to payment accounts. That means that service providers can access information about payment accounts from commercial banks without having to have certain contracts between them (Védís Sigurðardóttir, 2018). These new service providers can be split up to two different roles. One is PISP (Payment Initiation Service Providers) meaning that the service provider can make transactions straight from deposit account to another account. The other one is AISP (Account Information Service Providers) meaning that the service provider can collect information about consumers (Snorrason, 2017). Both roles must be approved by the consumer. The difference in the communication link is shown in Figure 2. This distinction between roles is important for the consumer because in PISP the service provider can make transactions from consumers account but in AISP he can only access consumers information. In January 2018, all members of the European Union should have implemented PSD2 in law. As Iceland is a member of the European Economic Area but not the European Union; they have not implemented PSD2 in law yet (Brynjólfsson, 2018).

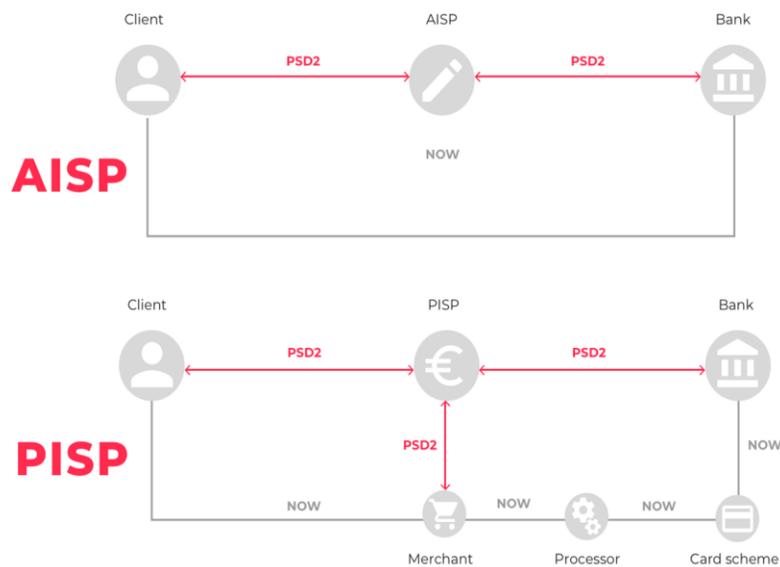


Figure 2: AISP and PISP with PSD2 (Blinking, 2018).

## **4. Methodology**

Research methods can be classified as either quantitative or qualitative. As stated by Steinar Kvale (1996) the two approaches are tools and their utility depend on their power to bear upon the research questions asked. They require different competencies, the researcher's ability and interest as well as the type of subject being the two biggest factors. Quantitative methods look to quantify phenomena, collect and analyze numerical data. Focused on a small number of attributes across many cases. Contrarily, qualitative data seek the meaning of phenomena and focus on a large number of attributes between few cases (Tuli, 2011).

Such methods take advantage of two separate reasoning, deductive reasoning and inductive reasoning. Deductive reasoning tests a theory as regards to a certain hypothesis. Working from the more general to more specific, narrowing the subject to a testable hypothesis. Inductive reasoning is considered to be the opposite as a specific case is observed and by that case a more generalized conclusion is reached. Both reasoning procedures are used in scientific investigations. In quantitative and causal studies, a more deductive approach is visible while in qualitative and exploratory studies an inductive approach is applied (Sekaran & Bougie, 2019).

### **4.1 Interviews**

The type of research that was chosen was qualitative research. The main reason is that there is little knowledge about the research phenomenon currently available. Deep interviews were carried out in order to obtain knowledge. Inductive approach is applied, as the objective is to explore certain options within a single case with means to theoretically generalize to others. Aiming to put forward propositions that can be tested with quantitative approaches. In terms of emerging technology mixed with complex legacy systems the expert knowledge lies with individuals and is not considered as common knowledge. In depth interviews are a tool to get that knowledge and can be highly informative if rightly executed. Interviews in qualitative research can be described as the miner metaphor where knowledge is understood as buried metal and the interviewer is a miner who unearths the valuable metal. The interviewer digs nuggets of data or meanings out of a subject's pure experiences, unpolluted by any leading questions (Kvale, 1996). By carrying out in-depth interviews we mine our experts of information that is vitally important to our research. Information that we consider to be hardly accessible by other means. The interviews were adjustable as certain questions allowed further explanation by participants.

### **4.1.1 Drawbacks of interviews**

In-depth interviews can have its limitations and there are a few things that the researchers must keep in mind while conducting in depth interviews. One of the limitations that researchers were facing was establishing reliability. As the researchers do not have expert knowledge or experience in conducting interviews it might result in reliability problems. Measurement without random or unstable errors is considered reliable, it contributes to consistent results (Schindler, 2019). Using a semi-structured question list that was adapted to each participant might result in a loss of reliability. Actions were taken to minimize the loss of reliability by using the same ground format of questions. As well as avoiding probing and leading questions. Generalization is another limitation that researchers had to keep in mind. As subjects were not selected randomly and the research was based on qualitative methods, findings cannot be generalized statistically on a larger scale (Kvale, 1996). Five out of six interviews were conducted in Icelandic. The interviews were transcribed in Icelandic and ultimately translated to English when writing summaries. This process might cause an error as some words and meanings could have been lost in translation.

### **4.1.2 Participants and implementation**

Interviewees selected for the research consisted of various experts. Staging scenarios for the future of blockchain inside the four largest parties in payment intermediation, required a broad perspective. Nonprobability methods were used to recruit researchers, with a mix of purposive sampling as well as snowball sampling. Purposive sampling as the participants were required to have a certain degree of knowledge about the subject and snowball sampling as they were often hard to reach (Schindler, 2019). Researchers aimed to interview experts in each field of payment intermediation. Software architecture specialists inside Reiknistofa Bankanna, IT solution and business development experts inside commercial banks, as well as fintech companies. To gain deeper knowledge to blockchain and how it might play a part. Interviews were carried out with experts in blockchain preferably with prior experience in the finance sector.

Interviews were carried out between 8th of April to 6th of May 2020. Due to unforeseen circumstances all interviews had to be conducted through video conferencing tools. Circumstances that will be further clarified in the chapter Research limitations. Measures were taken to maintain the benefits of in-depth interviews by using software that allowed live video and audio. All interviews were audio recorded and took between 31 to 55 minutes.

### 4.1.3 Analysis and instruments

A one set of predetermined questions was used in the interviews. The interviews were semi-structured aiming to start with a number of specified questions, “then follow the individual’s tangents of thought with interviewer probes” (Schindler, 2019, p. 130). The questionnaire involved a total of 11 questions including 4 base questions. Base questions regarding job title, education, prior work and knowledge of blockchain. Other questions were unstructured leaving the subject to speak freely on a specific topic. Four core themes were vital in structuring the questionnaire:

- What is the possible future of blockchain technology?
- In what way can the benefits of blockchain be of use?
- In what way could the limitations of blockchain hinder its progression?
- Are there any internal or external factors that might hinder the progression of blockchain?

The unstructured questions adhered to the core themes mentioned above although they were adapted to each subject as their role within payment intermediation varied. The objective was to gain meaningful insight to various aspects of payment intermediation, enabling subjects to further elaborate. The question list can be found in Appendix A.

After a short introduction to the research all subjects were asked to think about the future of blockchain within payment intermediation and their relevant sector. Following up with questions regarding viable properties, limitations, internal and external hindrances to blockchain. Concluding the interview were questions concerning whom inside payment intermediation might be likely to emphasize blockchain as well as if they see any other technology advancement progress. The purpose of the questions was to get the subjects to be imaginative, to think of the unthinkable. To identify the key drivers and reflect without certainty.

To further analyze the outcome of the interviews a condensation approach was carried out by the example of Kvale (1996). When forming a meaning condensation, a summary of interpretations is presented. Lengthy answers are abbreviated to a shorter group of sentences with the intention of illustrating the main themes (Kvale, 1996). The method involves a five-step approach. Starting off with reading the whole interview to summarize it. Followed by the identification of meaning units provided by the interviewee. Then researchers underline a natural meaning unit, a simple code that encapsulates the theme. After that the grounds of the research are revised whilst bearing the units in mind. In the end the main themes are merged, resulting in an

explanatory statement emphasizing the themes (Kvale, 1996). An abstract version of each interview will be presented in the Results chapter. These versions were used to code and identify possible themes; themes that will be interlaced and discussed in each scenario in the Analysis and Discussion chapter.

## 4.2 List of interviewees

Table 1: List of interviewees

<b>Job Title</b>	<b>Education</b>	<b>Reason</b>
Managing Director at Icelandic Blockchain Foundation	Commercial College of Iceland	An experienced programmer with extensive knowledge of blockchain. Finance enthusiast and a podcast host for the Icelandic Blockchain Foundation.
Head of Business Development at Landsbankinn	MSc. Information Technology	Worked in the banking sector for 15 years. Developing and deploying business solutions. Extensive knowledge of payment intermediation as well as knowing blockchain.
Chief Information Officer at Íslandsbanki	MSc. Information Technology	Broad experience in the banking sector, both domestically and internationally. Overseeing various bank IT developments. Well familiar with blockchain.
VP of Business Development and Consulting at Reiknistofa Bankanna	BSc. Computer Science	Over two decades of programming, overseeing and managing various banking IT solutions. Deep knowledge of the technical aspects of bank functions. Familiar with blockchain.
Co-Founder and Chairman at Monerium	MSc. Financial Engineering	Works at Monerium, an Icelandic blockchain based financial service. Experience from the banking sector for over 20 years. Wrote a publication on Blockchain for IEEE. Prior chairman at the Central Bank of Iceland.
CEO at The Fintech Cluster	BSc. Mechanical and Industrial Engineering	CEO at the Fintech Cluster. Extensive experience from the financial sector. Has been involved in innovation within fintech as well as other areas. Broad knowledge of emerging fintech companies.

### **4.3 Scenario planning**

Formally defined, scenario planning is “that part of strategic planning which relates to the tools and technologies for managing the uncertainties of the future” (Ringland, 1998, p. 2). To take on the uncertainty of the future; scenarios are a tool that tells stories. Stories that aid in adjusting and acknowledging for changes in the present world. Shedding light on how decisions made today might pan out. As predicting the future with certainty is impossible, scenarios are not predictions. Instead they are thought of as a tool to assist people to learn (Schwartz, 1991). Originating in the 1950s, a man named Herman Kahn evolved a technique that today is considered to be the birth of scenario planning. Kahn and his corporation managed multiple projects for the US military (Lindgren & Bandhold, 2003). Later, in the 1970s the scenario planning process had expanded and was commonly used by the gas company Shell. The planners at Shell led by a man named Pierre Wack aimed to consider the future of oil prices. As the oil reserves of the United States were declining, the demand for oil in the United States was rising. With certain disruptions in the Middle East, Pierre and his partners recognized with scenario planning the possibility of an oil crisis. Following the Yom Kippur war there was a turmoil in oil prices. Considering the large oil companies at the time, Shell was the only one that was prepared which led to their leap in success in the following years (Schwartz, 1991).

A research conducted by Jónsson (2011) investigated how scenario planning might be used within the strategic planning of Icelandic companies. Interviewing a diverse group of people working both in the public and financial sector, interviewees in general were pleased with the approach and found it useful. By gathering different opinions and evaluating different perspectives, participants agreed that scenario planning helped when the economy crisis erupted in 2008. Easing the uncertainty in the time of crisis was a recurring theme among participants as well as being prepared for the future (Jónsson, 2011).

#### **4.3.1 Constructing scenarios**

In order to construct scenarios, there are certain steps that have to be taken. As described by Peter Schwartz (1991) there are eight steps in constructing scenarios.

1. Identify Focal Issue or Decision
2. Key Forces in the Local Environment
3. Driving Forces

4. Rank by Importance and Uncertainty
5. Selecting Scenario Logics
6. Fleshing Out the Scenarios
7. Implications
8. Selection of Leading Indicators and Signposts

The preface of shaping the scenarios are the first four steps. Initially there is the need of recognizing the focal issue or the root of the decision. Followed by the diagnostics of the key factors and driving forces that influence the roots. To determine the leading elements, factors are ranked by importance and uncertainty. The factors that come out on top are then allocated on the axes that steer the scenarios. Further measures upon developing the scenarios include reevaluating key factors and the focal issue as well as investigate the outcome of each scenario (Schwartz, 1991). These processes and further analysis are presented in the Analysis and Discussion chapter.

## 5. Results

### 5.1 Managing Director at Icelandic Blockchain Foundation

He believes that there is an opportunity in automation in payment intermediation in Iceland, where the benefits of blockchain could come in. *“There is an increase in automation and more pressure on electronic processes. As it is today, the money system is disconnected from that system. Money isn’t being used in these increases in automation, and you begin to think that this has to be drawn closer, and then this is one of many possibilities that is being looked at”*. He then took an example of how a simple transaction is a today and how blockchain could come in hand in more complex transactions. *“So instead of how it is today, think of a simple transaction from A to B, then we have good systems but if you are going to pay 100.000 ISK over four months and pay 5% interest. How would you do that today as a person, then you have to calculate in excel and transfer, or the bank could set up four different payments for you that are all equal amounts. When you think of it this way, where are the opportunities, what are the use cases available, then it becomes an interesting concept”*. In that context, he mentioned smart contracts and how they can be useful. *“For example, if I don’t trust you, but I can see that the money is in escrow contract, and these are the conditions, then I know that I will receive the payment if all conditions are met.”*

When asked about the hindrances of blockchain in payment intermediation in Iceland, he talked about barriers of entry regarding what settlement currency is used. *“Barrier of entry yes, it depends on what settlement currency. As it is today, a very well-known settlement currency is used: the Icelandic króna, and no one asks twice about how you are going to send the amount. It is just an account number, and it receives ISK unless it is a dollar account, then it has other signs”*. He also talked about how the solutions would come in and that it will probably be stored in the back-end rather than in the front-end. He took an example of how cars have developed with new technology without the consumer realizing it. *“I think that with payment systems, it is about not using blockchain as a front-end solution but as a back-end solution in the solution as a whole. It is the same as with the car, they used to have no computers, and everybody drove their cars, but ten years later, the cars suddenly became computerized. No one was wondering about it, but suddenly the cars were starting to waste less, and the car was getting more efficient. I think this would be the same concept unless there comes a wave of more trust”*.

He pointed out when talking about how the systems are opening up with the PSD2 regulation that new incomers to the market would use all the available tools. That would be at the cost of the banks that have spent large amounts of money and time into solutions that new entrants could take advantage of. *“There are banks like Indó that are going in the direction of being a bank without being a bank concept. They will use all the tools that will be opened up. If we look at the banks, they have spent billions in making solutions and connections, but then some new startup comes to the market and starts to use something that they have spent blood, sweat, and tear building. The regulations are forcing them to open up, and they would never have done that in any other circumstances, so this regulation undermines the banks. However, everyone sits at the same table, and this monopoly is decreasing, so in the end, it is about who is the smartest and builds something that the consumers want”.*

Looking at the future, he talked about it was up to what the consumers are asking for. Regarding automation, one of the areas that he mentioned that blockchain could be beneficial, there must be a demand from the consumers that these processes will be simplified. *“It is about what is being asked for, and there is a demand for speed, lower cost, things getting more open and that you can switch rapidly between companies if you don’t like the service. The world is getting more complex though we have more tools. There are all kinds of complexity because of regulation and other things that are loading up. If the goal is to increase automation, then it must be the demand from the consumers that in the long run, these processes will be simplified. As a player looking at it from the outside, a blockchain is a screaming option in this case. The foundation in it is trust without third parties, 100% transparency and spread in processes”.*

When asked about which of the participants in payment intermediation in Iceland might utilize blockchain. Companies seeking more complex services are a viable option. He mentioned that the personal payment intermediation as it is today is somewhat a solved concept; it is not considered a problem. *“It is obvious for companies that connect to these systems that already exist and for companies that seek for more complex services. I see it with the companies, this personal payment intermediation is somewhat a solved concept, but the companies want more complex features in the system that they have access to”.*

He talked about the account to account or A2A following the PSD2 regulation. He believes that new technology in payment intermediation lies in smartphone usage and that institutions in Iceland have all hands on deck with increasing digital solutions. *“This is something that will affect*

*participants that haven't come up with any strategy on getting this on digital solutions on the phone. All these processes are powerful in payment intermediation though you are not necessarily transferring money with actions”.*

## **5.2 Business Development Manager at Landsbankinn**

He believes that blockchain technology has its benefits, but he wonders where the problem lies or if there is a problem. He named guarantee of ownership and relinquishment of real estate as areas that blockchain would fit in but again asks if there is a real problem in this area as it is today. *“Why would you take scenes like payment intermediation, registration or some kind of relinquishment and change them. What is the problem that is being solved and what is the added value”.*

It was his assessment that inside the banking sector, durable medium is something that blockchain could come in as a solution. He mentioned that it is something that is immutable and accessible to the customer for a long time. After the increase in digital solutions, there is this problem with the concept durable medium. Durable medium is a tool that enables the unchangeable, safe storage of information. *“This has been a debate and blockchain could potentially come in there strong. If this is accepted as a durable medium which it certainly is supposed to be. There are measures trying to create this durable medium on blockchain. But again, what is the problem, is there really a problem with durable medium today. There are split decisions about what durable medium is and people are trying to fulfill it with the best of ability”.*

He believes that blockchain would not add much to payment intermediation as it is today in Iceland, but he brought up foreign transactions. He talked about the speed in blockchain solutions and that could potentially be a solution for foreign transactions. As it is today these transactions are slow with Swift messages. *“New companies have entered that are doing this fast, they have funds in each country and are doing it on the same day. I looked at foreign transactions and thought that it could be the way. Someone could transfer ISK to Bitcoin, transfer it to another person who would sell it and move the money to euros. The problem with this is the fluctuation in these crypto currencies. If you are transferring 100.000 ISK then it could be 80.000 ISK 15 minutes later. That is one problem but there are certainly opportunities there”.*

There are more participants in the payment intermediation with the arrival of PSD2 and the systems opening more up. However, he assessed that the VISA schema is strong as well as the consumer refund claim. *“The thing is that the one that buys is strongly insured, this system fits the*

*consumer. For example, if you buy an item on Amazon and the item does not get delivered then you can get refunded. The acquirer takes care of charging the seller. Anything else for example like transactions. If you make a transfer for purchase and you do not get the item that you bought, good luck with the collect, you can't go through VISA with that. This is so important, there are so many that have cards and so many that have point-of-sale".*

Even though this Visa schema is so strong especially for the consumer there is another point of view and that is regarding the cost. He pointed out that the vendors do not endure indefinitely margins being pinched off the sale; customers will end up paying higher prices. *"This is the main reason for why different payment methods could work, because of the cost. Cheaper systems, preferably domestic payment systems, then we are not going through Visa and Visa has to get it's share, the acquirer has to get it's share and the bank has to get it's share. Everybody is pinching off the transaction".*

When asked about the lending sector and increase in competition, he had strong opinions. He talked about when it comes to loaning money you have to be strongly funded. Regulations regarding financial institutions state that they can only loan a certain percentage of the company's equity. *"This is how lending works, you loan X amount of equity and the rest as loan that the bank can get elsewhere. Fintech companies do not get loans with low interest rates. They are usually not allowed to receive deposits, you have to have a huge amount of equity and to be categorized as a deposit institution to be allowed to receive deposits. Therefore, you are badly funded, you have to loan with higher interest rates which means that you are scraping the bottom regarding quality. This is and will always be difficult for smaller participants to come into the loaning market with better terms than the bank can offer".*

### **5.3 Chief Information Officer at Íslandsbanki**

Starting off from a philosophical view, there are certain disruptions in the banking sector where blockchain might play a part. A piece of that being the open banking evolution. *"I think people get very excited about open banking. The fact that we are going to be able to allow non-traditional players to take part within banking, I think it is very exciting. A lot of interesting things will come out if it. I just do not think it will fundamentally transform the industry. If we go back to the core service that the bank provides, it will not change on the back of open banking. What I mean by that if you go and understand why the banks came to existence. It is based on the fact that they are*

*an intermediate trust provider*". He further explained how the change from barter trading to the monetary system evolved. *"There was someone needed to say that this guy is good for the money that he is promising you. In the barter system it was obvious that you could see if you had ten sheep or not. If I gave you a promissory note, someone had to say yes he got the ten sheep"*. Elaborating further on the open banking and blockchain. *"So, I think the banks are fundamentally there to provide trust as an intermediate between parties. Therefore, I think the long term application of blockchain and distributed ledger is way more the open bank side of things"*.

Moving from a philosophical view to the effects of blockchain, he believed that it will undoubtedly have an effect. It is only a matter of time as there are certain obstacles in the short term. *"I think it will have a significant impact on the financial system, not only within payments but in general as how we are a trust provider. The short-term issue that we have is a high hurdle of entry into the banking system. Because it is an international system it does not matter if you only look at Iceland. Iceland is a very open economy, we have to be able to try it with international banks and link into international payment systems. All the systems got a high barrier of entry. As an industry we are trying to figure out how to transition these systems that are built on historic concept and historic technology into the blockchain world. I think once we figure that out it will be a significant change. You can argue once we change the store of value to a mobile wallet, call it a personal wallet. The role of the bank will change fundamentally"*.

Taking a closer look at the benefits that blockchain technology brings. He believes that there are certain features that necessarily do not fit for the Icelandic context. Although it will break down how such a system would be implemented. *"Instant payments are something we have had forever in Iceland. But we also have not had a proper interbank settlement model operating within the market. You could sometimes think that we are running three big branches of a single bank opposed to three different banks. There is a lot of behind the scenes reconciliation and back office processes that we have built between the banks to support the instant payment model. I would not go as far as saying that we would not get a benefit out of utilizing blockchain in that world. I think if we do this correctly, it is trusted, and we can verify the transaction at that point in time of creating the blockchain. The effort of reconciliation should reduce significantly. Which will over time result in cost reduction of operating and managing those processes, ultimately giving us a cheaper banking system. The number of supporting systems would be reduced"*.

When asked further about the costs that Icelandic commercial banks are experiencing, he further explained his thoughts on simplifying payments with blockchain. *“The consensus building process (in blockchain) is a huge stumbling block for high volume transactions. I know they have been evolving it but one could argue are you not adding in the same reconciliation problem we have today in a slightly different framework. Looking at the different parts of the banking world. You got two types of technical problems we want to solve. First are high volume transactions. It may be simple transactions, but they are high volume. Before we see the true benefit in the payment world from a blockchain perspective, that still needs to be resolved.*

With the wide range of use cases mentioned for blockchain inside the world of finance. There is an active debate whether or not they are applicable. With the special case of electronic ID in Iceland there is a need for a trust provider. *“I think the prime example for me in Iceland is if we look at electronic IDs. The way we are doing it, how strict we are with the legislation and how invested the banks are in it as an authentication trust provider mechanism. You would expect that Auðkenni has been looking into where it will evolve. Similarly, we got digital signatures and the whole pending on smart contracts, I think these will naturally evolve more to a distributed ledger based solution. Maybe not in the classic form but in a hybrid form. I think time is the biggest hurdle. Not everything is going to be solved with blockchain. Even if we start utilizing it more in the next couple of years, it will take the banking sector 10-15 years to move on to blockchain solutions if ever. But I do think there are other drivers. We have not figured out how to utilize that connectivity that we have, sitting with buckets of information and do not know what we are going to do with it”.* As the case goes for interbank settlements and cross-border payments there are several different factors to consider. *“We are in the middle of implementing a new interbank settlement solution. We are not going to reimplement in two years again because there is a blockchain option. In 10 - 15 years it may go into a blockchain solution. Foreign payments is a different discussion, Swift initially ignored blockchain but they started transitioning to blockchain. As a bank we have to upgrade to the new Swift standards and there might be an opportunity for us. A cross-border payment is an expensive transaction that is very inefficient and it is something we would like to get better at”.* He believes smart contracts might be a viable solution in electronic signatures. *“Now we are stuck with a digital solution that is not acceptable by þinglýsing so we need to get that aligned. This is where we will evolve the fastest if we can get an agreement. If there is a direct statement that says if we do smart contracts then it will be accepted by þinglýsing,*

*we will change it immediately. At the moment there is a bit of a disconnect on what exact direction is going to be from þinglýsing. Auðkenni, þinglýsing all of those they call island.is, these smart nation items we can evolve with smart contracts.*

Mentioning few of the considered weaknesses of blockchain solutions such as user and legal acceptance, he believed the complexity of the blockchain might hinder its progression. Followed up with the politics and polarization of cryptocurrencies. *“One of its limitations is its perceived complexity. What I mean by that if you really look at it’s very elegant how it’s put together and a beautiful idea. But it is like trying to explain to people TCP and IP. People are a bit unable to visualize how to use, where to actually apply this. I think another shortcoming is that the digital currencies have become a bit philosophical and political. Digital currencies have become a bit of a stumbling block for blockchain. People are getting stuck on not exploring blockchain because they think Bitcoin is not a proper currency. Bitcoin got a place and digital currencies have a place and we need to be careful in disregarding them. But that is one of the challenges that blockchain got, that bit of bad press”.*

Focusing on the internal and external threats to the progression of blockchain solutions. He was positive that with the coming generations and blockchain becoming mainstream that there are few if any threats substantially hindering blockchain’s progression. *“As knowledge and skills are built up, the new generation is going to university and it is a part of the curriculum you start to know how to play around with it. These things evolve into mainstream developing and technology areas. I’m quite positive, I will go as far as saying in the next two to three years most of the banks will be running a blockchain solution of some sort”.* With the special circumstances in Iceland that the commercial banks are interconnected to the Central Bank via RB. He believed that it would not prove as a threat. *“There is a current discussion on the go where we are talking about where do we re-focus RB more into a utility provider. A year ago, I might have said yes as RB has some aspirations to compete with the banks. I think that has changed now and the drive now is how do we best structure RB as a utility provider. I would rather see legislative issues as a hurdle rather than things like RB. If FME turns around and says you are not allowed to use distributed ledger from a regulated perspective, then we are stuck”.*

Exploring the different participants in payment intermediation there are several opportunities. However, it remains unclear who and when these opportunities will be seized. *“The obvious answer would be fintechs. The problem with fintech is that after PSD2 they have to get*

*into the banking system via the commercial banks to process payments. It is not an open payment infrastructure, they cannot influence the end to end process. I think the opportunity exists inside the Central Bank as there is a big drive to push account to account payments. As a commercial bank, we do not make money off payments. Our focus will be on where we make money. Promoting blockchain solutions in areas like trade, cross-border payments, lending and smart contracting. Those areas where we can make money opposed to pure payments. I would say the Central Bank has got the opportunity from a payment perspective".* When asked about the probability that fintech's might provide similar services to banks, he believed it might happen in the long term but there are complications. *"You might get some interesting fintech solutions. But we will face the same challenge, people in Iceland are not used to paying for transactions. You are going to need a serious value proposition to convince people to pay 5 krónur, 10 krónur per transaction".*

#### **5.4 VP of Business Development and Consulting at Reiknistofa Bankanna**

When asked about RB and possible usage of blockchain solutions he mentioned the international scope. Looking at cross-border payments as they are today. They are slow and expensive. He then said that RB will be more likely to look at solutions that have already been built rather than develop solutions internally. *"So, I see RB starting to partly open up on these ways and participating in them. Not finding the solutions rather look at those with potential. We are looking at P27 and Ripple and wondering if that is going to be something, possible payment intermediation of the Nordic countries."* He then mentioned that the role of RB was to connect the domestic solutions that we already have to these new solutions that seem to be feasible. *"I think the role of RB is to be the gateway. Helping with getting payments from the domestic part to something like that. If something gets dominant in this area and the first steps have been taken, then I think it is not unlikely that these technologies will be used in the domestic solution here. I think that it will progress in that way, starting with a startup and when there has been some experience with it then it's going to be implemented."*

Trust is one of the things he mentioned and that payment systems as they are today are built on trust that is a bank's credit within the Central Bank. He talked about that he was excited about how things are going to progress with digital currencies, especially within the Central Bank. *"I am very curious about how the progress of digital currencies will be. For example, RB would definitely participate with the Central Bank if that would be reality. Central banks all over the*

*world are wondering about whether to release digital currency. It would obey the same laws as regular currencies but with another technology. In my opinion that would be a possibility.”*

Following that discussion, security in payment intermediation is something that the current government is speculating about. European countries are cautious about the large tech companies developing their own payment solutions. *“Countries in Europe are wary regarding the development and are saying that they won't accept these associations that do not obey under the same regulation as theirs. For example, the banks in Iceland are getting a demand from the National Security Council saying that they have to come up with some solutions with payments for Icelanders that are not dependent on Visa or Mastercard.”* He then talked about the difference in debit card usage here in Iceland one hand and in Europe on the other hand. *“We have different debit card usage then in Europe to that extent that as we do it there is just a transaction from your account but in the abroad the debit cards work similar to credit cards. The settlement is done later in the month and goes through Visa and Mastercard schemas. Here in Iceland this has been built as a national solution but now they are moving away from that and card schemas are to an increasing extent putting more pressure to moving to the international settlement systems. Because of that there is also this pressure from the Central Bank, and I think that could be a use case.”*

Talking about the weaknesses of blockchain, complex technology along with user and legal acceptance. He talks about how the first use cases will be where you do not add too many people to the complexity. *“This first use cases I think where we use blockchain is where you don't add too many people to the complexity. For example, if you are building an app where you are paying in the store and that ends up as a withdrawal from the account. For the regular user, he is not wondering if there is a blockchain technology behind it. The same as if the Central Bank releases digital currency, you just log in to some online bank and see a number that is in Icelandic krónur. I think with these weaknesses you just hide it from the user.”* Following up with what could hinder blockchain solutions being used. Talking about internal and external factors he did not see them as hindrances. *“I think that it would rather help than hinder. Central banks will fight against that Bitcoin will be commonly used as it means black economy. The central banks are in reality just going into competition by releasing central bank money as a digital currency that is controlled by the central bank itself. For example the Central Bank of Iceland to use the technology and release Icelandic digital currency that obeys Icelandic law. They can continue to raise and lower interest rates. It is regular currency but with new technology.”*

## 5.5 Co-founder and Chairman at Monerium

When looking at the potential of blockchain solutions inside payment intermediation he pointed out that there will be solutions where you do not need an intermediary. It will start with companies wanting to increase automation in their processes before we will see it as a solution for individuals. *“It is likely that it will start within companies that are increasing automation in their processes. They want to be able to program the payment part by themselves in their solutions. That eliminates intermediaries. Not to mention for business to business processes. I think it is longer until individuals will use it. There are certain conveniences in having for example a bank to take care of this. So, this will happen in steps and will likely coexist. That is to say some will take care of payment intermediation for certain sectors but there will also be sectors that won’t need the payment intermediation part and will use and count on blockchain entirely.”* Following that he talked about how things are progressing inside central banks regarding digital currencies. There is a lot of speculation about the role of the banks whether they should be in between or not. *“If you look at what the Bank of England has been writing. They assume an increase in issuance of digital currencies on blockchain and underlying funds safeguarded by central banks. The central bank’s balance sheets will expand accordingly. That will have consequences since banks play an important role today. If you make banks more obsolete then it will influence many things. For example, how money is made in the economy.”*

Moving on to what could hinder blockchain gaining ground in payment intermediation he mentioned the interests of the banks withholding current systems. In that context he took an example how Kodak got under with the appearance of digital images. *“People did not foresee that digital images would ruin a company like Kodak but that happened. However, I think the banks do understand this and that they must participate in this change that is happening. Most banks will adjust to this new world that is in creation.”* Another thing mentioned that has been a problem scaling for some blockchains, i.e. it can only handle a relative low volume of transaction per unit time. However, that is something that can be solved. *“For some blockchains, scaling has been a problem. For example, public chains that rely on proof of work. However, by different design, such as proof of stake instead of proof of work, and by further developing the technology this can be addressed. There is also the thing with privacy. But again, there are prominent solutions that address this in development”*

He said, when asked about how he sees the banking sector develop, that there are two things that the banks should be aware of. Banking will become more global and the role of central banks will change. *“Banking will become more global. It will be easier to do business across borders. It will be cheaper, easier and more modular. Then there is the role of central banks that will change to the extent that they will take advantage of this technology in one form or the other. Competition will be a global competition. In Iceland there have been few banks that own the market and have not needed to worry about new entrants. Over time it will be more realistic and cheaper for others to compete with them. Also, I think in the near future the role of central banks will change. That will influence what services the banks are providing. Banking is not vanishing, the competition will just increase and it will become global, and the banking sector will adjust accordingly.”*

Talking about changes in payment intermediation in Iceland and how fintech companies are coming into the market. He said that ten years ago you could not send payments without going through RB. *“With Monerium e-money on blockchain anyone can transfer payments between them without any intermediation. You don’t need RB anymore for such transactions. That in itself is quite a change. However, that doesn’t change that individuals are used to use credit- and debit cards and pay via point of sale terminals (POS terminals). There exists a whole infrastructure that supports this kind of transaction. But from a technical point of view this could all be replaced with mobile phones and e-money on blockchains. Initially the infrastructure is a barrier of entry for new payment solutions. Apple pay and Samsung pay are building on top of the old infrastructure system. However, that is obviously only a temporary solution. They don’t need to rely on this infrastructure once users have their money on blockchains.”*

Regarding smart contracts he talked about settlements in e-commerce such as shares and bonds. As it is today you have these intermediaries that guarantee that the one that is going to buy will pay in the end. *“You have these institutions like Kauphöll Íslands. Partly it is because you must have someone that takes care of the transaction and makes sure that people pay in the end. With smart contracts you can guarantee the transaction, when you exchange one digital asset for another, instantaneously and securely without having to trust your counterparty. The transaction doesn’t go through unless both parties receive their respective digital asset. You do this through smart contracts and by that you remove the need for a trusted third party like an exchange.”* He also talked about how it used to be and the opportunities that do exist. *“Parts of current payment intermediation exists because - until ten years ago – online transactions needed an intermediary to*

*secure the transaction. A mutually trusted third party was needed. This all changed in 2008 when the blockchain technology was first introduced and more so when Ethereum introduced its first live smart contracts in 2015. The market is slowly realizing this change.”*

## **5.6 CEO and Founder at The Fintech Cluster**

Elaborating on blockchain in general he believes there are certain implications that blockchain might prove as a solution to multiple problems. *“The blockchain technology is astonishing as it solves a big problem concerning the decentralization of power. Along with the collaborative effort of the peers that maintain the network. I think that this is a progression, especially if we look at it from a constitutional perspective concerning the decentralization of power. In reality it is incredibly imaginative that it can be a trusted system even though it’s by decentralization”.* Refocusing on the payment intermediation, he finds it hard to predict with certainty as possibilities are numerous. Applications regarding electronic currencies and smart contracts might prosper. *“I do not think there is a single answer to this matter. The options are diverse and the development is rapid. There is one thing that I think is extraordinary and important is what Monerium is doing, enabling fiat currency on blockchain. In addition to that I think there are a lot of possibilities regarding smart contracts and managing credit risk. This is a world that could possibly expand. It is vital that it is on a common platform that anybody can program on and it is not controlled by a single entity.*

Looking at possibilities inside payment intermediation in Iceland he said that there is a basis for the Central Bank to release digital currency. *“The Central Bank of Iceland has been looking at what the Central Bank of Sweden has been doing with e-krona. I think there is a basis for that, it depends on how it is implemented. If it is implemented with a public blockchain to some degree, then you don’t need the systems. You can program directly against the blockchain. Blockchain itself is a system, a distributed system.”* As to the implementations of blockchain based solutions, exciting prospects are emerging. *“There is one company called Alein payments founded by Ingi Rafn Sigurðsson the CEO of Karolina Fund. They are using blockchain to split payments between parties. For example, a crowdfunding project is set up and funds are promised, then the distribution of funds is executed automatically between the relevant parties. It then manages the credit risk. Another viable use case for Alein is Bókun. A system acquired by TripAdvisor, they offer service from multiple parties in one bundle. Payment would then be rightly distributed”.*

Philosophically, he believes that cryptocurrencies have a place in the future. *“I think currencies similar to Bitcoin will matter. Bitcoin is the main one even if it varies in value. I believe that there is a ground for cryptocurrencies, because they provide freedom. Without the interference of governments and the banking sector. In my opinion there is a future in that.”*

Following the discussion with blockchain and possibilities he mentioned how cross-border payments are complex and there is an opportunity there. *“If more countries will put their currencies on blockchain then people are able to have faster transactions between the currencies.”*

Moving on to how the payment systems are built up today and how he sees for example Monerium coming into the market. *“I think what Monerium is doing could be something that could work well without the banking system taking part in it. They could create a system on the side. You imagine that people can create electronic accounts and electronic claims and they are then paid on blockchains. The blockchain takes care of calculating the claim, you can pay into it and have a proof of payment. I think that this is one of the strengths. It is theoretically possible to do this on the side of these systems, to a large extent at least.”*

When talking about weaknesses that lie on blockchain today and what could hinder blockchain to gain its ground, he talks about the unknown unknowns. He also mentions cryptocurrencies. *“First of there is these unknown unknowns, something that you don’t know what is. There are possible weaknesses that we have not seen yet. There is a lack of regulation regarding digital currencies. Also, there is some prejudice towards cryptocurrencies and that can be a problem.”*

## 6. Analysis and discussion

In this chapter the results of the research will be presented. An analysis and coding of interviews is set forth. Themes from each interview are generated and applied to the development of scenarios. Scenarios are developed with respect to the ideology of Schwartz (1991). Each scenario is then fleshed out and evaluated in conjunction with emerging themes.

### 6.1 Interview analysis

Each interview was processed and coded according to the condensation approach as presented by Kvale (1996). Researchers identified the meaning units and then evolved the apparent themes.

Table 2: Themes from interviews

Interviewee	Themes
Managing Director at Icelandic Blockchain Foundation	<ul style="list-style-type: none"> <li>• Automation</li> <li>• Account to account (A2A)</li> <li>• PSD2</li> <li>• Smart contracts</li> </ul>
Head of business development at Landsbankinn	<ul style="list-style-type: none"> <li>• Cross-border payments</li> <li>• Credit card schemas</li> <li>• Rivalry in loaning</li> </ul>
Chief Information Officer at Íslandsbanki	<ul style="list-style-type: none"> <li>• Barriers of entry</li> <li>• Reducing efforts</li> <li>• Smart contracts</li> <li>• Cross-border payments</li> </ul>
VP of business development and consulting at Reiknistofa Bankanna	<ul style="list-style-type: none"> <li>• Cross-border payments</li> <li>• Central Bank Digital Currency (CBDC)</li> <li>• Payments outside VISA and Mastercard</li> </ul>
Co-Founder and Chairman at Monerium	<ul style="list-style-type: none"> <li>• Central Bank Digital Currency (CBDC)</li> <li>• Smart contracts</li> </ul>
CEO at The Fintech Cluster	<ul style="list-style-type: none"> <li>• Smart contracts</li> <li>• Central Bank Digital Currency (CBDC)</li> <li>• Cross-border payments</li> <li>• Cryptocurrencies</li> </ul>

A summary of these themes revealed three recurring terms. Terms that will hereafter be discussed and perceived when developing scenarios. These three themes are cross-border payments, open banking and smart contracts.

Cross-border payments are one of the themes as it was a red thread in the interviews. There is room for improvement inside the cross-border payment area. As it is today these transactions are slow and bear high costs. According to the interviewees, many believe that these transactions can be improved by using blockchain solutions. Solutions taking on this problem have surfaced but they are yet to reach mass markets, nevertheless they are constantly evolving

Open banking is the second theme. A term that combines the evolution of regulations such as PSD2, digital currencies within the Central Bank, providing payments beside the traditional credit card schemas and new entrants to the sector. There is pressure from the government on ensuring independent intermediation of payments. Account to account solutions unstrained from the traditional VISA and Mastercard schemas. Among some, there is an undertone that one should be able to store funds electronically outside the commercial banks. Calling for a more transparent system. The sector is opening up which allows for innovation in the area of payments. There was a general consensus in the interviews that this is an exciting topic and blockchain is a potential tool for further innovation in that area.

Smart contracts are the third main theme. Smart contracts have been establishing themselves in the financial sector as well as others. Yet they have not gained a lot of ground in Iceland. Contracts implemented electronically have been increasing within institutions. Mentioned in most of the interviews, smart contracts have rich potential and the benefits are evident. Various use cases were discussed both inside and outside of payments. Electronic signatures such as Auðkenni, electronic IDs, various registrations as well as stocks and trades.

## **6.2 Scenario analysis**

The initial thought process of scenario planning starts with recognizing a decision or addressing an issue. Arising from the roots and implemented as an inside-out process. First the decision and then the environment (Schwartz, 1991). In this research the issue is Blockchain. As an emerging tech, it is yet to make a full impact on society. Companies today have yet to fully utilize the technology even though its widespread recognition. Questions such as how, when and why blockchain will be implemented have not been fully answered.

The next step is identifying the factors that ultimately shape the outcome of a decision. Factors that stand in the way of success and failure. Parameters that are vital to the decision maker (Schwartz, 1991). As the key factors have been identified, the next step is to distinguish the driving forces behind them. In the interest of listing up those forces thorough research was conducted as well as interviews with experts. In recognizing the forces, it is vitally important to consider the different aspects that influence the factors. Certain or uncertain, foreseeable or not, they might all play a part in shaping the future (Schwartz, 1991).

Similar to this research, Valfells and Egilsson (2017) conducted a research on blockchain and the future of financial services. A relatively broader scope as it goes beyond payments. A stakeholder analysis by the example of Porter (2008) was carried out along with other strategic planning tools. The key forces identified in this research such as rules and regulations and new entrants hold certain similarities to theirs. The difference is that the scope here is explicitly set to payment intermediation in Iceland. A research conducted by Guo and Liang (2016) aimed to examine the application and outlook of blockchain in the banking industry in China. Assessing the diverse use cases of blockchain, they consider the new entrants, technological advancements and regulations among other things to shape the evolution.

By analyzing the interviews, the key forces were put forth. Changing rules and regulations are considered to be impactful. Regulations are forcing banks to open up in a way that they would never do under any other circumstances (Founder at the Icelandic Blockchain Foundation, personal communication, April 8, 2020). Although it is still a work in progress and the final outcome is unclear. After PSD2, companies still have to go through commercial banks to process payments. It is not an open payment infrastructure as they cannot influence the end to end process (CIO at Íslandsbanki, personal communication, April 28, 2020). It might as well prove as an obstacle. For example, if the FME turns around and says the commercial banks cannot use distributed ledgers from a payment perspective. Then they are stuck (CIO at Íslandsbanki, personal communication, April 28, 2020). In a way intertwined with changing rules, new entrants are emerging. Banks like Indó are going in the direction of being a bank without a bank concept. (Founder at the Icelandic Blockchain Foundation, personal communication, April 8, 2020). Companies specializing in fintech are emerging but have to apply to certain conditions. For example, they are not allowed to receive deposits and not as well funded as the commercial banks (Business development manager at Landsbankinn, personal communication, April 21, 2020).

The advancement of technology is another factor. The development of blockchain solutions or other systems. Some obstacles do exist as the consensus building process in blockchain is a stumbling block for high volume transactions. High volume transactions are one of the problems identified within payments (CIO at Íslandsbanki, personal communication, April 28, 2020). Even for the limitations that have been identified, they are solvable. There are solutions that are addressing these limitations and this is developing (Co-founder and Chairman at Monerium, personal communication, May 5, 2020). Payment intermediation and its implementation in Iceland depends on development overseas. Swift originally ignored blockchain but has now transitioned to blockchain (CIO at Íslandsbanki, personal communication, April 8, 2020). RB is looking at solutions like P27 and Ripple and wondering if it is a possible solution between the Nordic countries (VP at RB, personal communication, April 30, 2020). European countries are following the development of large companies providing ways of payment. They will not accept a main form of payments that does not obey their rules. Commercial banks in Iceland are getting a demand from the National Security Council that they have to find ways to provide payments besides Visa and Mastercard (VP at RB, personal communication, April 30, 2020).

Current stakeholders within payment intermediation will play their part in forming the evolution. Central banks are interested in digital currencies. The opportunity exists inside the Central Bank on exploring blockchain solutions considering payments. (CIO at Íslandsbanki, personal communication, April 8, 2020). The Central bank in Iceland has shown interest in the electronic version of Icelandic króna named Rafkróna (VP at RB, personal communication, April 30, 2020). Reiknistofa Bankanna might have had some aspirations to compete with the banks a year ago. There is a current discussion on how to refocus RB as a utility provider (CIO at Íslandsbanki, personal communication, April 28, 2020). RB are likely to start opening up regarding new solutions. Utilizing existing solutions rather than building them (VP at RB, personal communication, April 30, 2020). The landscape of commercial banks is changing. Since the banking market in Iceland is small, the banks have not needed to worry about new entrants. In coming years, it will be easier and cheaper for others to compete with them (Co-founder and Chairman at Monerium, personal communication, May 5, 2020). If and how they will take advantage of the blockchain technology is fairly unknown. Commercial banks do not make money off payments. Their focus will be set on where they make money. Blockchain solutions in trade,

cross-border payments, lending and smart-contracting might be viable (CIO at Íslandsbanki, personal communication, April 8, 2020).

Table 3: Key Factors and Driving Forces

<b>Key Factors</b>	<b>Driving Forces</b>
Rules and Regulations	Payment intermediation is heavily regulated with a high barrier of entry. Framework similar to PSD2 changing the landscape
New Entrants	Fintech and other companies aiming towards the banking sector. A sector that can be seen as oligopolistic is opening.
Technological Advancements	Progression of blockchain, changes in current infrastructure as well as other emerging technologies.
Development Overseas	As a part of an international system, payment intermediation in Iceland is influenced by decisions abroad.
The Central Bank	Overseeing the financial system as well as owning a part of the payment systems, the Central Bank plays a large role.
Reiknistofa Bankanna	Serving as an adapter from the Commercial Banks to the Central Bank, RB develops and implements banking functions in general.
Commercial Banks	Large established institutions that have been going through some sort of a transformation. Experiencing high costs.

There are two deciding scales that must be considered when ranking key factors. Initially they must be ranked, based on how important they might be to bring success to the original issue. Subsequently they are ranked by the level of uncertainty encircling key factors and their driving forces. Scenarios cannot vary by fixed factors that are inevitable to happen as the scenarios will then bound to be the same. The purpose of ranking is to pinpoint the factors that can be considered as most important as well most unpredictable. The top ranked factors will accommodate the axes that will determine the scenarios. Seen as the most important step of the process, the dimensions

provide a framework to shape the scenarios. For the process to fulfill its purpose the scenarios are based on few variables that influence the outcome of the issue (Schwartz, 1991).

Participating parties in payment intermediation in Iceland were considered as the most influential factor in this research. Based on the interviews, a number of transformations are expected to take place. Rules and regulations will continue to evolve. Possibly colliding with the interests of RB and the commercial banks. The Central Bank has been experimenting and evaluating their options on progressing the payment systems. New entrants have emerged and taken roots. Today, all these entities are interconnected by the payment systems but based on the interviews and research there is some friction in the sector. Whether there is a substantial transformation on the horizon is highly uncertain and requires further exploration. The preceding elements were incorporated in a term called industry rivalry.

The possibility of substitute technology is the second factor. In deciding on implementing a blockchain system, current infrastructure and other emerging software is seen as substitute technology. Varying with the purpose of the technology the magnitude of threat differs. In determining the prevalence of blockchain, the possibility of substitute systems is vital. With different use cases there are different levels of substitute possibility. Among the driving factors and trends making an impact are new entrants to payment intermediation, foreign systems, internal and technical progression of existing and new systems.

Upon classifying the factors and determining the guiding forces, expanding the scenarios was done by revisiting step two and three. Every individual key and factor should be represented by one way or another in the scenarios (Schwartz, 1991). The two concepts were carefully combined and intertwined into the dimensions, industry rivalry and possibility of substitute technology. They are similar to two of the five competitive forces that shape strategy, put forth by Porter (2008). Certain similarities arise from the process of creating the scenarios and analyzing the five forces by Porter. The two concepts are a part of strategy planning and can be combined. Although in this research the scope is set to investigating the possible effect and prosperity of a certain technology rather than the industry profitability. Industry rivalry as defined by Porter (2008) participants are similar in scale, industry growth and exit is restricted and competitors are highly invested. By some means that corresponds to prior analysis, here industry rivalry will additionally consider new entrants and shifts in rules and regulations. Threat of substitution is measured to the extent, products in the same sector fulfill the same purpose in a different way

(Porter, 2008). Threat of substitute technology in this research will be interpreted as the possibility of substitution. It refers to existing and newcomer technologies that fulfill the same roles as blockchain technology might. Taking into account their international and domestic advancement.

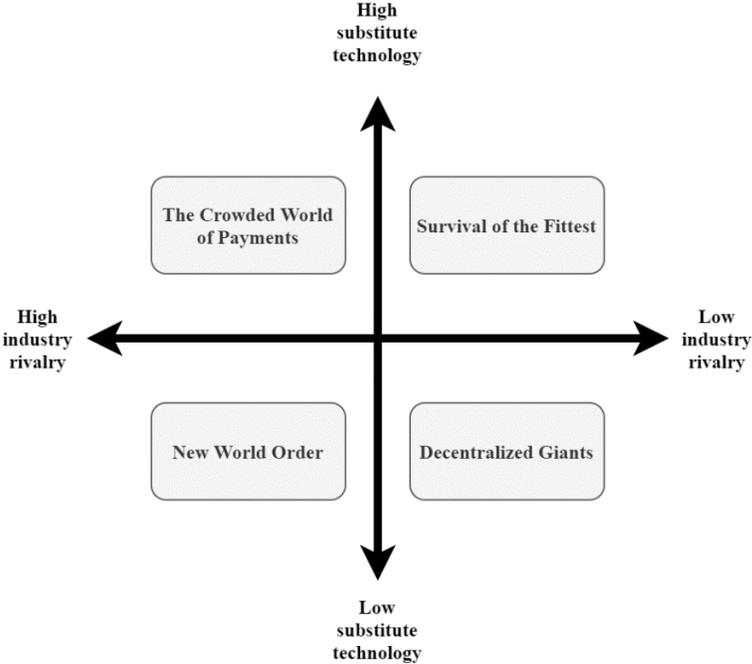


Figure 3: Scenario dimensions.

### 6.3 Scenario 1 - The Crowded World of Payments

Technologies will continue to develop at this rapid pace. Blockchain will however not be the obvious choice of selection. Limitations such as scalability will not be solved efficiently. The progression will be halted since the common weaknesses will not be promptly solved. Competition inside payment intermediation will increase. Rules and regulations will continue to develop towards the spirit of PSD2; unfolding the access to participate. New entrants come into the market and grab market share from current stakeholders. The banks will keep on building on top of the payment systems and make them more efficient. Real time gross settlement functions are in place and blockchain will not necessarily be an added value. RB will continue to develop parallel to changes in the financial sector. It will shift its focus to consulting and software solutions outside of the banking sector.

Cross border payments will get more efficient as the technology keeps evolving. They will get faster and bear lower costs but that will not be with the help of blockchain solutions. A variety of options will emerge in handling such payments. Blockchain solutions will only be deployed on a small scale and it will not be the main framework.

Open banking will continue to develop as third-party developers gain more ground. As stated before, blockchain will not be the obvious choice of selection however it will be used for specialized functions but not as the main framework. Visa and other card schemas will hold but other possibilities will be presented. Consumer's strong refund claim through acquirers will keep these financial service companies relevant. The sector becomes more accessible and more participants will emerge. Modernistic online banks with no physical branches, emphasizing transparency and empowering the customer. Central Bank Digital Currency will surface yet not gain mass market usage.

Smart contracts will gain some ground. Various contracting systems will continue to develop. Applying for loans and electronic signatures will be a similar process as it is today. Concepts such as Auðkenni will continue to be steadily used but will not be efficiently solved with blockchain technology. Smart contracts will be used for more specialized terms and on a small scale. Trading stocks and bonds by smart contracting will be experimented with.

## **6.4 Scenario 2 - Survival of the Fittest**

Payment intermediation will continue to develop but in general stay similar as we know it today. The big players, commercial banks will strengthen their positions leaving fintech companies behind. Interbank settlements will continue to go through RB and to the Central Bank. Barriers of entry to the payment systems will prevail new entrants to enter. Blockchain based solutions will evolve but will not overhaul current systems.

Cross-border payments will develop inside the banking sector. Blockchain solutions will not make their way into payment intermediation because of the high barrier of entry. Stakeholders will not experience a problem in the market that blockchain solutions will help with. Systems that are being implemented today will continue to blossom. Software such as P27 and other solutions provided by companies to make cross-border payments more efficient. Solutions such as holding funds in each country and transferring them between countries and banks in an efficient manner.

Open banking will allow new entrants to the market such as fintech companies, but they will be capped as they do not have the funds to compete with the banks. Big foreign companies will recognize the benefit to spread their services to Iceland. Regulations will continue to evolve but the rigid structure of the sector will stay in place. Companies operating within payments will have to communicate with commercial banks in order to process payments. Digital currency provided by the Central Bank will be implemented. However, current ways of payment will stay strong. Banks will compete on similar grounds as today, they do not make money on payments and will focus on other aspects.

Smart contracts on blockchain will not gain a lot of ground. Contracts as we know them today will keep evolving and we will see institutions rely more on electronic contracts but without blockchain solutions. The infrastructure operating on stocks and bonds will experiment with blockchain, but the evolution is slow. Electronic IDs are widely used and will continue on the same path.

### **6.5 Scenario 3 - New World Order**

The payment intermediation as we know it today will change. New entrants will appear as rules and regulations continue to make the sector more accessible. These entrants consist of both domestic and foreign companies. Fintech companies continue to provide new ways of transferring and purchasing. Large companies, Facebook, Amazon, Apple will come into the market with new ways of payment. Facebook will continue to develop their currency and Apple Pay will be implemented outside of banks. Blockchain technology will overcome its limitations and prove as a viable asset to functions of payments.

Cross-border payments will get more efficient with the implementation of blockchain solutions. The benefits will be evident in faster and cheaper transactions especially for the service provider. There will be various offerings on providing cross-border payments. Specialized systems similar to P27 will still thrive. As the options increase competition will harden. Multiple banks might provide different sorts of cross-border payments. Some will operate on existing systems while others might emphasize distributed ledger payments.

Open banking will be characterized by more competition in the financial market. The traditional oligopolistic landscape in the Icelandic sector will shift. New banks with different approaches will be established as well as foreign institutions might tap into the market. Companies

fully and successfully utilizing blockchain will reap the benefits of entering a stagnated sector. Substitutes to the traditional card companies will surface providing an efficient way to transfer funds via blockchain. Companies such as fintech companies will add value to customers when handling payments, possibly enhancing trust by using blockchain technology. The Central Bank will announce a digital currency of some sorts as it corresponds to international development.

Smart contracts will come into play and play a pivotal role. Trading, stock exchange and authentication will be based on smart contracts resulting in elimination of intermediaries. Paper contracts will be close to non-existing. Blockchain will to some extent be a resource in registrations, electronic IDs and handling of applications.

## **6.6 Scenario 4 - Decentralized Giants**

Blockchain will be integrated into current systems. It will somewhat be a backend tool in the whole solution. The blockchain technology itself will continue to develop facing the weaknesses that have been addressed. Today's players in payment intermediation in Iceland will adapt to this new technology and use the benefits to make current systems more efficient. New entrants in the market will show but they will not be compatible with the giants on the market. The high barrier of entry will continue to be a hindrance for new entrants. Systems serving as intermediaries in the current structure will be removed. Blockchain based tools enhance processes saving computational power as well as costs.

Cross-border payments will get more efficient with the help of blockchain solutions that have been developing in recent years, for example Ripple. The existing companies handling cross-border payments such as Swift will continue to lead. As the structure is in place the process will be amplified by blockchain. Drawbacks of the process, cost and time inefficiency will be addressed and solved.

Open banking will slowly develop. Banks will benefit from the slow development. They will look to improve their statue and take advantage of emerging technologies. The process of adaptation might lead to a different outlook of banks, but the number of participants will not increase greatly. Rules and regulations allow new entrants to certain areas but they still have to operate through commercial banks.

Smart contracts will improve various aspects of the solutions that have already been established. Island.is incorporates smart contracting to some of their work that involves

authentication and validation. Stock Exchange of Iceland enables smart contracting when trading. These changes will not necessarily be visible from the customer perspective other than a more pleasant experience. They will not necessarily relate it to a change in technology.

## 7. Conclusion

The staging of scenarios based on research and expert interviews pursued the anticipation of outcomes. After six interviews it was concluded that enough information had been gathered. The purpose of interviewing experts from all branches of payment intermediation had been achieved. Coming back to the research question:

*What effects blockchain could have on payment intermediation in Iceland?*

Inspecting the scenarios there are certain indicators that will lead the way. Indicators that will prove as predecessors to the progression of blockchain. We conclude that it is likely the role of RB will change in the future. RB will continue to evolve towards consulting. There are indicators that bank functions will not be confined to RB. New real-time gross settlement system that is owned by the Commercial Bank will include functions for 3rd party connections. There is pressure from the government on the commercial banks on securing payment intermediation outside of the usual card schemas, VISA and Mastercard. Rules and regulations have detached the rigid structures of payments allowing fintech and other companies to enter. However, they are still obligated to perform their actions through the commercial banks. Probabilities will not be placed on each scenario. Nevertheless, there are indicators that the industry rivalry is growing and the number of substitute technologies will increase.

Allowing new entrants to enter the sector of payment intermediation will further strengthen the development of blockchain. Entrants that are not running on the same legacy system with the complex structure of the commercial banks. Substitute technology is one of the most uncertain factors. How the blockchain technology overcomes its limitations is still partly an unanswered question even for some promising prospects. Parallel to that, present and other systems are evolving as well. Payment and interbank systems were recently renewed and it is considered to be the solution for next 10-15 years.

The main conclusion and it is an important point that in general payment intermediation is not thought to be a high value problem in Iceland. State of the art retail netting system is in use and has provided instant transfers for years. The system is still run through a number of intermediaries with associated computational and other costs. It is not considered to be replaced anytime soon. Between Italian banks, reconciliation processes are being solved with blockchain.

Implementing a similar process in Iceland is not as relevant, the level of complexity differs. It is a matter of cost-benefit analysis between current systems and blockchain systems. Cross-border payments proved to be an option in possibly utilizing blockchain. The transactions are currently expensive and inefficient. The Central Bank of Iceland has shown interest in issuing a Central Bank Digital Currency called Rafkróna; possibly implemented with blockchain technology. The size of the market is something to consider. Iceland is a small country and it is expensive to develop software solutions. From the interviews, we can conclude that current stakeholders inside payment intermediation are looking for solutions abroad rather than building them themselves. Domestic blockchain solutions will follow the development overseas. Throughout the research we reached the conclusion that blockchain is merely a tool. Tool with characteristics that might solve certain frictions within payments, but its effect could reach far further than that. As mentioned by one of our interviewees nobody was talking about TCP and IP back in the day, but it is a fundamental piece of the internet. The widespread recognition of the technology is proof of its rich potential but overcoming its limitations is the first step to success.

## **7.1 Research limitations**

The research was carried out with a qualitative method using deep interviews. Since we only have six interviewees it is hard to generalize about how things are going to progress in the future. In that context, the interviewees of the research are all men so that can cause gender bias. A mix of the sampling methods selected as well unforeseen circumstances restricted researchers' ability to establish an even gender ratio. Subjects were asked to point out feasible persons to interview and all were men. Even though progress has been made it still seems as a male dominant sector.

The research was conducted in unprecedented times where the pandemic COVID-19 raged over the world. That set limitations with the interviews as they had to be done through electronic communications tools rather than eye to eye. This pandemic also made it harder to reach these interviewees since they were busy with other things regarding effects on their workplace caused by COVID-19. Another limitation that must be mentioned is that the researchers are not experts in interviewing techniques which can affect the answers of the interviewees. Following that the researchers have not worked with scenario analysis before.

## **7.2 Further research**

Several interesting features of the research would be worthy of further research. Exploring the possibilities of enhancing cross-border payments with blockchain. Pay close attention to solutions that are addressing the problem, solutions like Ripple that have been implemented on an international scale. As mentioned before qualitative research methods like interviews are good for generating propositions that can be tested. A quantitative approach, for example a hypothesis on efficiency comparison regarding cross-border payments could be carried out. Then comparing the solutions that are in place to new blockchain solutions. A further research regarding the transformation of banks would be viable. How the open banking discussion might alter the traditional bank functions, for example a quantitative approach on changing competitive grounds and its effects on human resources. The changing role of RB is an interesting point of view. An adapter that has glued the technological pieces of the Icelandic banking sector for decades. With the broad knowledge and expertise, they can become a software development powerhouse. Further research on smart contracts is something that we conclude inevitable. With the increase in electronic contracting we propose smart contracts as a feasible choice that can be tested further here in Iceland. As the development is rapid this research might very well be outdated sooner or later. Companies are investing heavily in blockchain research and solutions taking on its limitations are emerging. The need for constant research and reevaluation on the topic is important.

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## 9. Appendix A: Questions

What is your knowledge on blockchain?

*Adjusted to subject – Appropriate field is the field of payment intermediation that the expert works inside*

**Key question:** How do you see the future of blockchain in payment intermediation (*Appropriate field*)

*In continuation*

In what way could the benefits of blockchain be useful in payment intermediation inside (*Appropriate field*)?

In what way could weaknesses of blockchain hinder its usability in payment intermediation inside (*Appropriate field*)?

In the future. Can you see any other factors hinder blockchain solutions inside (*Appropriate field*)?

### **General**

Looking at payment intermediation in general. Do you consider anyone likelier than others to emphasize blockchain technology in the future?

In which way and why?

Can you envision any other technology development in payment intermediation in the future?

### **Base questions:**

What is your job title?

What is the highest level of education that you have completed?

Have you worked in other jobs in recent years?