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Scenario-based Roadmapping of Blockchain in the Financial Payments Industry

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Preface

About seven year ago, seventeen years old and starting with my bachelor in Mechanical Engineering. Clearly focused on pursuing a career in a hardcore engineering discipline. A lot happened in the last few years.

After touching some other disciplines during my bachelor and experiencing during my first career focused job that engineering is usually not driving developments in the world of technology and innovation, a broader knowledge base was necessary to grow further. I realised that I liked the more strategic and tactical activities and high-level approach of engineering. Furthermore, the last couple of years, business and data related activities provided me with the biggest joy. Hence, a master in Management of Technology seemed like good place to start and the specialisation in ICT management and design provided me more insights and knowledge regarding more topics that interest me.

This research project for my master thesis came across by pure chance. After approaching Marijn Janssen about some topics regarding RPA, IoT, and E-sourcing/ E-procurement, he pointed out that there is one vacancy left in his thesis supervision group regarding "building future scenarios of blockchain in the financial sector and developing a roadmap". I have always been fascinated by blockchain and was not familiar with scenario planing or roadmapping research approaches. A big challenge, throwing myself in the deep, and figuring it out, is what gives me energy. So, I accepted this offer and got started. Now, I can proudly present my master thesis. In my opinion, a truly new piece of knowledge for the academic literature field and managerial knowledge base.

The report is intended for anyone that is curious to explore blockchain from a high-level perspective, particularly the use of blockchain in the payments industry. Complex problems and aspects of blockchain developments are being discussed, however, the topics are discussed in an understandable language. Readers with extensive knowledge on either the payments industry or blockchain technology can view some part as elaborate.

The responsibility of the research project is obviously to me as a master student, however, I could not have done it without the excellent supervision on my first supervisor Jolien Ubacht. Her dedication and invested time is significantly more than what is standard practice. Weekly meetings and iterations of reviewing my deliverables and chapters has truly created this thesis to a much higher level of quality. My chair, Marijn Janssen, also provided the necessary guidance, especially regarding my research approach for the scenario planning and roadmapping. I would like to thank my second supervisor as well, Zenlin Roosenboom-Kwee, for always responding on a very fast notice, flexible attitude, constructive feedback, and the occasional motivational talks.

Furthermore, I am very grateful for all the experts that managed found time to participate in this research project. The collaborative knowledge, enthusiasm and broad knowledge base concerning blockchain, with a focus on finance, truly elevated the relevance and quality of this thesis. I would also like to thank Nadia Metoui for assisting during the scenario design process and her help in moderating the workshop. Her contribution is truly amazing due to her ad hoc decision making during the workshop. Moreover, thanks to Alessandro Fergnani, Marysa Vos, and Antony Valiaveetil for the feedback regarding the scenario workshop design process.

Lastly, many thanks to my family and friends for their unconditional support. Thank you for the interruptions when I needed to clear my mind. I especially want to thank my mom, dad and sister for giving me the space and time to pursue my dreams, and their believe in me.

Shivaye Jagesar
Delft, July 2022

Summary

Blockchain is famously known for its applications in the cryptocurrency space, with staggering market caps and volatile movements, widespread attention cannot be missed in society but also not in financial markets, especially the payments industry. With financial institutions in the centre of the payments industry, blockchain becomes the first possible application scenario, due to the natural interconnection between various financial actors. Nevertheless, the academic literature is not clear on which financial application should be developed first, where blockchain is currently heading in terms of disruptiveness and lacks empirical studies that incorporate professionals from the financial sector. This research project is devoted to addressing the uncertainties surrounding these knowledge gaps and setting the foundation for fulfilling them.

By having a research objective that is focused on technology forecasting and strategic planning, the described knowledge gaps are addressed. The research objective is to build future outlooks of blockchain in the payments industry and develop strategic planning for financial institutions. The future outlooks show possible images of where blockchain development could head and strategic planning identify in available strategic pathways towards those possible images. A subsequent research question is drafted to research this objective, Which strategies are available to remain competitive in the blockchain-based future?". Hence, answering the main research question creates insights by which financial institutions can develop their blockchain endeavors and remain competitive in a blockchain-based future.

To answer the research question, a qualitative scenario-based roadmapping method is utilized to create a proper foundation to answer the research question and reach the objective surrounding technology forecasting and strategic planning. Scenario-based roadmapping is described as "*a carefully designed and implemented blend of scenarios planning and roadmapping can offer the best of both world*" (Strauss & Radnor, 2004, p. 51). After reviewing potential scenario-based roadmapping methods, the method of Hussain et al. (2017) was chosen, which in turn is backed by the book "Scenario Thinking" from Cairns & Wright (2017) and the roadmapping approach of Strauss & Radnor (2004). The qualitative activities of this research method translate into workshop and interview activities to collect data. A workshop is used for scenario development and interviews for the roadmapping.

The scenario development has a foundation in a literature review that synthesized various driving factors for blockchain developments in the payment industry. Interesting examples from this literature review are political factors such as central bank digital currencies (CBDC) and self-governance risks, economical factors such as cost reduction, economic dependency, and risk in early adoption, and technical factors such as bottom-up technology-push, scalability, interoperability, social factors such as fear of missing out, consumer protection and culture changes, legal factors such as leveraging intellectual property (IP), enforcement, and accountability.

Based on these driving factors, a scenario development workshop was driven. This successful workshop resulted in new driving factors and insightful discussions as well. This workshop resulted in the choice of two most impactful and uncertain driving factors for the future of blockchain, namely, governance and regulation. The scenarios are developed based on two extremes of these driving factors, each with two extremes, law of the jungle versus state incentives CBDC and libertarian versus strict/ detailed/ comprehensive regulation, respectively. Resulting in two scenario narratives, namely, **Techno-verse** and **Big Brother**.

Scenario **Techno-verse** represents a combination of "law of the Jungle" and "Libertarian". It is driven by BigTech dominance and the digital/ technology entities that are ruling. Given that Blockchain is everywhere, the world revolves around web3 and other blockchain applications, resulting in an ecosystem where there is no place for a traditional bank because everyone can become a bank. Scenario **Big brother** represents a combination of "State incentivized CBDC" and "Strict/ detailed/ comprehensive regulation". This scenario is driven by a national blockchain-based payment system, which is diffused country-wide and controlled by a government. This system will form the backbone of the payments system in the financial markets. Financial institutions are forced to participate in this system if they want to remain a significant player in the payments industry.

With the developed scenarios, a strategic plan is developed for financial institutions to reach them, resulting in a multi-scenario roadmap. This multi-scenario roadmap is based on the following activities. An evaluation of the developed scenarios is conducted on various levels, such as government, industry, corporate, and society. Based on this evaluation, the necessary strategic steps to reach a scenario are derived and merged into layered pathways. Thereafter, flex points were identified to check if pivotal shifts in the strategic pathways could happen. Together, they are used to develop the multi-scenario roadmap. The scenario evaluation, pathway construction, and flex point identification are supported by interviews to validate the synthesized data. Given the highly uncertain world of blockchain in finance, there are quite some flex points discovered, Market Regulation, Market Leaders, Interoperability, Accountability, Cyber Security, and Efficiency. Each of these aspects has the potential to shift the development field of blockchain in the future in the payments industry.

To answer the main research question, *"Which strategies are available to remain competitive in the blockchain-based future?"*, all the information is synthesised and resulted in the following findings. The future outlooks from the perspective of financial institutions in the payments industry are sketched in the form of **Techno-verse** and **Big brother**. Strategic pathways show how blockchain can be competitively developed in the future from the perspective of financial institutions. Blockchain can be developed by tweaking the strategy of financial institutions in the realm of the possible strategic pathways and flex points that are constructed in the possible future outlooks of the techno-verse and Big Brother through a multi-scenario roadmap. In both future outlooks competition from BigTech, new entrants (Fintech) and public blockchain initiatives are forming a threat to the current financial institutions. The multi-scenario roadmap contains strategic pathways that can be used to leverage this competitive environment, resulting in available strategies to remain competitive in a blockchain-based future.

From a managerial perspective the financial institutions, there is a need to define checkpoints based on the strategic pathways, continuing with validating the assumptions that have been made, signaling external developments and scenario descriptors, and monitoring their current progress. Based on these activities, GO/No-Go decisions can be made at certain periods in the multi-scenario roadmap. Furthermore, from an organizational perspective and industry viewpoint, financial institutions can replicate the process steps from this research project to further explore how blockchain can be developed within other future outlooks. This list of actionable items provides financial institutions with handles to navigate in the fast-changing field of blockchain developments. External developments and their effects can be put in perspective based on the analysis that has been performed in this research project. Based on these activities and obtained knowledge, financial institutions are informed on how they can remain competitive in the blockchain-based future.

This research project is focused on blockchain in the payments industry from the perspective of financial institutions. Future research should conduct similar research in other areas of the financial sector and from other perspectives, such as government/ regulatory, society or new entrants. Further, future research should dive into the newly discovered driving factors from the scenario development workshop. These future endeavours can also validate the contextual factors from this research project. Moreover, continuous research projects with an empirical nature should be conducted, as this research project provided new and fresh perspectives regarding untouched aspects of blockchain development, such as recent events in this fast-moving space of blockchain, e.g. the impact of the recent stable coin crash. Lastly, future research should also focus on the complexities surrounding regulatory and governance aspects regarding blockchain, for example, for accountability aspects, as one respondent from an interview noted: "People are still very confused. Everybody is just asking questions. Nobody is providing any answers."

Acronyms

AHP	Analytical Hierarchy Process
AI	Artificial Intelligence
AML	Anti-Money Laundering
BC	Blockchain
CBDC	Central Bank Digital Currency
CIA	Cross Impact Analysis
CSR	Corporate Social Responsibility
DLT	Distributed Ledger Technologies
DNB	De Nederlandsche Bank
FCM	Fuzzy Cognitive Maps
IFS	Interactive Future Simulations
IP	Intellectual Property
KYC	Know Your Customer
MoT	Management of Technology
NFTs	Non-Fungible Tokens
P2P	Peer-to-Peer
PEST	Political, Economical, Social, and Technological
PESTLE	Political, Economical, Social, Technological, Legal, and Environmental
RPA	Robotic Process Automation
SDG	Sustainable Development Goals
TIC	Trend Impact Analysis
TRM	Technology Roadmapping
Web3	World Wide Web 3.0
WoS	Web of Science

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1 Introduction

This chapter will start with a topical introduction regarding blockchain in finance. Thereafter, problems, knowledge gaps, objectives, and (sub) research questions are presented. To finalize, a short overview of this thesis is described in the final paragraph of this chapter.

1.1 Blockchain in Finance

Blockchain is booming in society, especially the most well-known application of cryptocurrencies. These coins are currently at a staggering market cap of around 2000 Billion US Dollars (Early 2022) (CoinMarketCap, 2022). The first cryptocurrency was introduced in 2008, called Bitcoin. The "true-believers" of Bitcoin argue that Bitcoin could become a supra-national currency, eventually replacing national currencies (Lipton, 2017). Based on its current market cap (800 Billion US Dollars), these stories and ideologies get much attention (CoinMarketCap, 2022). Due to these developments, blockchain is often only correlated with cryptocurrencies or Bitcoin (Peter & Moser, 2017; Daluwathumullagamage & Sims, 2021). The Blockchain wave is not as well recognized as the Bitcoin wave, however, this momentum is currently changing (Zhao et al., 2016). Bitcoin is backed by blockchain, it cannot function without this underlying technology (Bateh, 2019). Blockchain goes further than cryptocurrencies, they are only a form of application of blockchain (Chang et al., 2020). Blockchain is in turn a technology that falls under the umbrella of distributed ledger technologies (DLT) (ECB, 2016).

1.1.1 Blockchain Technology

Distributed ledgers are not something new. Lipton (2017) elaborated that historically these types of systems occur naturally when power or property changes hands. During certain events, power or property was transferred between entities. These processes were governed by legislation and documented in ledgers. The information was spread across respected parties for legitimacy and version control of the ledgers. These activities resulted in a primitive version of a distributed ledger. The birth of blockchain, a new type of distributed ledger can be traced back to the white paper written by Santoshi Nakamoto in 2008. This paper described a digital version of cash, creating the opportunity to transfer payment between parties without any intermediary (Pal et al., 2021). This version of cash was backed by a distributed database that contained the records and shared those among participating parties of the system (Osmani et al., 2021). Distributed databases with joint writing have existed for decades, however, what made this new version of cash so special was that the integrity of the distributed databases (ledgers) was cryptographically ensured (Lipton, 2017). Every transaction is checked by a majority of participating members of the system. Information cannot be erased, the information is verifiable (Osmani et al., 2021). This is the greatest selling point and the biggest commonality between the reviewed literature, a system without the need for trust.

This system got known by the name of blockchain, a chain of blocks (Fernandez-Vazquez et al., 2019). The block is the collection of timestamped records or transactions (ledger). These blocks are cryptographically attached to one another and thus forming a chain. These blockchains are shared across a network, which makes it a distributed ledger (ECB, 2016). It is essential to understand that not all distributed ledgers are categorized as blockchains; however, all blockchains are falling under the scope of distributed ledger technology. Besides the trustworthiness of blockchain, there is a significant characteristic that makes this technology so popular among society, academia, and the financial industry. The obvious characteristics are the distributed nature (decentralization), irreversibility of records, and time stamping of records (Peter & Moser, 2017; Ozili, 2019; Chang et al., 2020; Choo et al., 2020; Pal et al., 2021). Further, security, computational logic, and transparency characteristics are important for all the actors involved. These are the characteristics that are fundamental for trustworthiness. However, depending on the used cryptography and consensus mechanisms, security and transparency can be modified (Ozili, 2019; Choo et al., 2020; Chang et al., 2020). One study on the topic by Hameed (2019) noted an interesting characteristic of blockchain, an economic incentive mechanism. This mechanism is attracting participants in the network that are willing to utilize their computational power to perform the calculation to process the transactions cryptographically. This is creating the ability of blockchain to support trustworthiness in transactions via networked computational transactions instead of human monitoring and control (Zhao et al., 2016). Before diving into the opportunity of blockchain in finance, a financial taxonomy is necessary to map the various stakeholders and activities of the financial sector.

1.1.2 Financial Taxonomy

Besides, widespread attention from society, blockchain is continuously getting more attention in the financial sector. According to Chang et al. (2020), blockchain serves finance very well, finance is a natural scenario for the application of blockchain. This is because the finance world is naturally interconnected, for example, banks and intermediaries are constantly performing transactions with each other due to the activities of market participants. This ecosystem can be improved with characteristics of blockchain such as decentralization, time-stamping, and irreversibility of transactions. Even with the criticized volatility of the best blockchain application so far, cryptocurrencies, the value of the underlying technology cannot be denied as financial organizations and institutions consider blockchain a more viable technology. This interest can be seen in the increasing amount of funding towards experiments, collaborations (consortium), and laboratories (Osmani et al., 2021). Examples of these developments are presented in paragraph 1.1.4. This paragraph will present a high-level overview of the stakeholders in the financial sector that are involved in blockchain-related developments.

Participants	Stakeholders
Financial Institutions	Firm Management
	Employees
	Shareholders
	Blockchain Service Providers
	Creditors
Financial Intermediaries	Auditors
Government Agencies	Regulators
Financial Resourced and Seekers	Investors
	Customers
	General Public
FinTechs	Blockchain Service Providers

Table 1: Financial taxonomy of blockchain related areas and participants in the financial sector

The introduction of Fintech makes keeping the overview more complex. As Pal et al. (2021) defined, Fintech is a combination of The terms “Financial" and "Technology”. It refers to technological applications in providing business solutions for the financial sector or the marriage of technology and finance (Chang et al., 2020). Fintech organizations are sometimes not even recognized as financial organizations if they fall outside the scope of financial regulatory frameworks. In those cases, the literature views these organizations as non-financial firms (Chang et al., 2020). In the financial taxonomy of this research project, Fintech organizations are recognized are as participants in the financial sector. These Fintechs often function as blockchain service providers (Daluwathumullagamage & Sims, 2021). Further categorization of these providers is possible in the areas of applications and solutions, services and infrastructure, base protocols, and middleware. Fintech organizations are currently growing at an unprecedented pace, providing newly developed digital financial services (Daluwathumullagamage & Sims, 2021). Another study on the topic by Peter & Moser (2017) noted the unprecedented growth of blockchain FinTech organizations, especially in the blockchain industry, as there are over 700 FinTech organizations in blockchain-based products and services.

At last, with the current description of financial organizations and services, a taxonomy can be created for the financial sector where blockchain is applicable according to the reviewed literature. These blockchain applications primarily revolve around the participants and subsequent stakeholders listed in Table 1.

1.1.3 Opportunities for Finance

In the previous paragraph, the financial actors with an interest in blockchain are mapped. This description elaborated on the fluid boundaries in the financial sector. Lipton (2017) discussed why blockchain is interesting for these financial actors. For example, when taking a closer look at banks, they are only functional as a group. Due to this nature, banks become interlinked with each other and blockchain can become a for handling the transactions between these interlinkages. To create an overview of the described opportunities of blockchain for the financial sector, Gan et al. (2021) defined five streams of academic research topics that can be used for categorizing the opportunities; cryptocurrencies, process innovation, business models, financial digitalization and disintermediation, financial regulation, and financial inclusion.

Cryptocurrencies
The application of cryptocurrencies is interesting for financial actors. As Gan et al. (2021) noted, Cryptocurrencies close a gap and meet requirements that appeared unachievable; secure, tunable privacy, and high-performing blockchain application with little waste. Moreover, as Lipton (2017) added, another form of cryptocurrencies can be Central bank-issued digital currencies, also known as CBDC. These CBDCs can deal with the societal ills in the form of financial-related crimes such as money laundering.

Process Innovation
One opportunity is crystal clear when diving into the literature on blockchain in finance, process optimization that results in cost reduction. When looking at real-time domestic transactions, the system works quite well but it is expensive and not that efficient for foreign transactions. Putting the inefficiencies in perspective, trading can take place in a millisecond, yet clearing and settlements can take up to 1 - 3 days (Lipton, 2017). Blockchain can fundamentally change the process flows and centralized structures of today, resulting in a far less expensive system and significantly increasing the transaction processing time (Peter & Moser, 2017; Osmani et al., 2021).

Business Models
Profit-seeking can be executed in multiple ways, either by saving costs or creating more revenue. The previous opportunity was focused on saving costs, this opportunity is focused on generating more revenue. Examples of new business opportunities in the literature are new forms of financing with coin offerings for startups, novel multilateral financing mechanisms, open markets for finance data that can be the driving force of discovery and innovation, usage of smart contracts for new automated products and services, improving the settlement of international trade, asset transfer and protection, certifications (e.g. documentary business in foreign trade finance), real-time transaction and credit monitoring, and P2P lending (Peter & Moser, 2017; Bateh, 2019; Gan et al., 2021; Pal et al., 2021; Valeria et al., 2022). Apart from new business models in financial areas, the paper of Valeria et al. (2022) recognized the development of intellectual property (IP). Financial actors who can become a front runner in blockchain applications for financial purposes in a proprietary way can become a licensor of the technology if that is the goal with the IP. Yet, there are still many uncertainties on how these new business models would be realized.

Financial Digitalization and Disintermediation
The paper of Ozili (2019) discusses the financial intermediaries of the financial system. Financial intermediation brings high costs to the financial system, leading to high costs of individual borrowing, delays due to necessary third parties, and included costs of regulatory compliance. As Valeria et al. (2022) recognized, banks begin to understand the benefits and are looking into blockchain to improve the quality of their financial products and services. Due to the decentralization, blockchain can become an automated and secure financial platform (Gan et al., 2021). The decentralization results in disintermediation and automation in more digitalized financial systems. Digitalization and disintermediation are linked to cost reduction, as earlier discussed, and create opportunities to focus on other activities than the ones that can be automated. Besides, the financial system of today does not offer a fair platform for individual borrowers. Fair in the perspective of having the opportunity to directly exchange monetary resources between individuals, also known as Peer-to-Peer (P2P) lending in the literature (Ozili, 2019).

Financial Regulation
private banks are the gatekeepers of the financial system, providing know your customer (KYC) and anti-money laundering (AML) services. KYC and AML services are not limited to banks. These services consist of activities related to dealing with information asymmetry, verification of identity, and credit risks (Chang et al., 2020). Private banks are the system policemen and the activities of financial actors are being monitored by financial regulators. These financial actors need to prove to the financial regulators that certain activities and requirements are not neglected. These processes and services are personnel and technology-intensive, blockchain can increase the efficiency of these processes and services (Chang et al., 2020). The distributed characteristic of blockchain allows for streamlining of the processes by establishing data ownership and promoting data sharing for KYC and AML processes between financial actors (Guo & Liang, 2016). Further, evidence provision to financial regulators can be enhanced and made more accessible due to the increased auditability (Hameed, 2019). Besides KYC and AML, blockchain has merit for other processes where fraud and reconciliation is crucial, such as monitoring of loan use, counter-terrorism financing, global regulation of capital circulation, and corruption and bribery crimes (Peter & Moser, 2017; Chang et al., 2020; Zetzsche et al., 2020; Gan et al., 2021).

Financial Inclusion
Financial inclusion is not well discussed in the reviewed literature. Financial inclusion suggests that every human being must have access to financial products and services. Blockchain can help with providing financial products and services without geographical dependence (Daluwathumullagamage & Sims, 2021). Another study on the topic by Gan et al. (2021) elaborated that focusing on financial inclusion can stimulate growth for inclusion of the unbanked population in financial systems. On the other hand, Daluwathumullagamage & Sims (2021) noted, that this situation creates opportunities for financial actors to gain access to a much broader capital base.

Recent Events
Recently, the blockchain world has become more dynamic, as (Guo & Liang, 2016) noted, blockchain is the next disruptive internet innovation. This direction is aimed at creating a blockchain-based internet, making the internet more fair and sovereign (Forbes, 2020). Another example of blockchain development is the non-fungible tokens (NFTs). These developments leave more creativity for new financial products and services but make the future more uncertain. Further, established blockchain-based applications, often cryptocurrencies, suffer from an image problem. These applications are linked with financial fraud, scandals, commercial fraud, or scams (Pal et al., 2021). This image problem creates a negative public perception and could harm blockchain diffusion. Apart from public perception, regulators are left with numerous questions due to the rapid pace of developments, image problems, and serious interest by industry (Ozili, 2019). It becomes clear that the future of blockchain is quite uncertain.

Common Denominator
Overall, the opportunities are quite divergent in their potential financial application areas. Nevertheless, an indirect link to payments can be viewed as a common denominator for most opportunities. First, cryptocurrencies are proposed as a new form of payment alternative with interesting upsides. Second, process innovation described inefficiencies in transactions. Third, new business models are fairly aimed toward the payments spectrum, for example, smart contracts, real-time transactions, and P2P. Fourth, financial regulation opportunities are directly linked to the payments systems. Hence, the research project must have the payments industry as a key focal point.

1.1.4 Developments in Finance

The previously mentioned opportunities for the financial sector are theoretical examples in the literature regarding the potential use of blockchain. This section will look at the development of blockchain driven by financial actors. The developments described in the literature follow another categorization than the opportunities. The categorization of developments is taken from Daluwathumullagamage & Sims (2021), as also used in the financial taxonomy paragraph 1.1.2. A synthesis table has been created to show where the most blockchain development is happening according to the reviewed literature, presented in Table 2.

Developments →	ET	KYC	Payments	P2P	Trade Fin.	Syndicated Len.	Insurance
Papers ↓							
Guo & Liang (2016)	x		x		x		
Peter & Moser (2017)	x		x	x			x
BATEH (2019)		x	x				
Chang et al. (2020)	x		x				
Dozier & Montgomery (2020)			x			x	
Daluwathumullagamage & Sims (2021)	x	x	x	x	x	x	
Osmani et al. (2021)	x		x				
	ET: Exchanges and Trading						

Table 2: Synthesis table of blockchain in the financial sector driven by financial actors

The earliest paper of the reviewed literature, Guo & Liang (2016), provided various use cases in the financial sector. The first use case started with payments, especially in payment clearing. The paper describes that since 2015 large financial actors started planning blockchain bases projects, examples of a consortium such as the R3 blockchain consortium and individual actors such as Goldman Sachs, J.P. Morgan, and UBS are provided. The R3 blockchain consortium is a collaborative group of large financial

actors to improve back-end processing and reduce operational costs using blockchain (focus on payments). Some of these actors have their own established (private) blockchain laboratories. Further, the next type of use case discussed in this early paper is in the stock exchange market. One example is the startup Linq which has partnered with Nasdaq, Linq is a blockchain-based transaction platform.

The paper of Peter & Moser (2017) presented a commonality in payments and exchanges and trading developments. However, also suggested that P2P applications of blockchain will be an interesting development in the future of finance. Further, this paper highlights that an insurance company is evaluating blockchain usage for compensation payments, based on the smart contract principle. An interesting conclusion of this paper was that with all the mentioned opportunities and developments, none of the survey respondents has the intention to utilize blockchain currently.

A more recent paper Bateh (2019) presents, again a commonality in payments. However, adding that the R3 is also developing standardized architectures for private blockchain ledgers. A difference in developments presented by this paper is a use case of blockchain by Deloitte. They are developing systems for smart identity and KYC purposes. This study states the impact of blockchain by 2030, is expected to disrupt the traditional financial organizations.

The papers of Chang et al. (2020) and Osmani et al. (2021) are quite similar to the two early papers on the developments of blockchain in finance, with the example of R3 and Nasdaq partnership with Linq. Nevertheless, the paper of Chang et al. (2020) noted that the Bank of America drafted 35 patents related to Blockchain. The paper of Dozier & Montgomery (2020) is also focused on payments, yet, The paper of Daluwathumullagamage & Sims (2021) has a lot more use cases, as previously mentioned in the categorization explanation. This summation shows that the payments and exchange and trading areas of finance are the most developed areas for blockchain.

The earlier papers mentioned a hesitant intention regarding blockchain implementation. The study of Dozier & Montgomery (2020), a relatively recent paper, still noticed these hesitant intentions. The study pointed out that the participating organizations in the study are evaluating blockchain, most are looking into blockchain for almost three years currently. Nevertheless, none of the participants mentioned large-scale development or even a production implementation of blockchain within their organization. The participants still see themselves as parties in an early stage of evaluating the technology. Yet, the overall expectations of the participants regarding blockchain were positive for the next ten years. Moreover, the status quo for blockchain in finance is best described by the following explanation of a participant, there is a need to understand blockchain today, if a significant opportunity arises in the future, financial actors are ready to move quickly. This is also recognizable in the prioritization of the participants regarding blockchain, more than half prioritized blockchain as low. A reason for this prioritization is other technological innovations, such as developments in faster payment, artificial intelligence (AI), or robotic process automation (RPA), are prioritized higher. The study highlighted that this development is due to the quantifiable, clear-cut, and better reachable near-term business cases linked to these other technologies. A hard conclusion came forward in this study, it seems that blockchain is a solution looking for problems to solve. The next section covers which scoped problems will be addressed in this research project.

1.2 Problem Identification

This introductory chapter described various topics regarding blockchain in finance. First, a description of blockchain technology and a quick overview of the financial institutions, their operational areas, and activities related to blockchain. Second, the opportunities and developments of blockchain for finance in the literature are categorized and described. Given the mentioned opportunities and developments, it is clear why the future is so uncertain and financial institutions struggle to find clear business value from blockchain. There are too many options, applications, and configurations. Apart from the mentioned perspectives, there is much more uncertainty when the technical domains such as blockchain architectures are included as well.

1.2.1 Knowledge Gaps

The literature as a whole presented some gaps that are merely touched upon or completely neglected. The following gaps have been identified in the literature;

- As described in 1.1.3, there is the potential of new business opportunities when blockchain is utilized, the literature is quite shallow on concrete examples of these new business opportunities. Future research is necessary to establish what these new financial products and services can be.
- Further, for these new business opportunities or process innovations of current financial operations, the literature is not clear which financial application should be developed first. The literature lacks to indicate the low-hanging fruit or the path of least resistance for blockchain developments in finance.
- Moreover, another knowledge gap is that the literature is not clear on the matter of where blockchain development will be heading, in terms of disruptiveness. There is mentioning of blockchain as an additional ICT system, a new business opportunity, or as a disruptive backbone infrastructure (next-generation system).
- Lastly, empirical evidence on real-world implications is missing in the literature. Utilizing professionals from the financial sector in future research will provide more empirical evidence that can shed light on these matters. The papers of Chang et al. (2020), Dozier & Montgomery (2020) and Peter & Moser (2017) are based on interviews and surveys with professionals from the financial sector and managed to describe aspects that were not covered in the rest of the reviewed literature.

The mentioned knowledge gaps are pressing a need for technology forecasting and strategic planning of blockchain in the financial sector due to the high uncertainties in the field of blockchain in the financial sector. This type of research is necessary to create possible future outlooks of blockchain in the financial sector. By researching these possible futures, the direction of blockchain development can be defined and guided with strategic planning. Furthermore, utilizing professionals from the financial sector is desired for future research, leading to more realistic future outlooks. When positioning this research project in an empirical environment, possibilities arise to validate the current trends in the blockchain literature, or at least provide a quantification of the future uncertainties, advantages and barriers related to blockchain diffusion in finance.

1.2.2 Scoping

What is interesting is the spread of developments in the financial sector, as presented in a synthesis table, Table 2. Exchanges and trading and payments are the highest-scoring areas of development, with payments as a dominant area of blockchain development in finance. As the literature presents that the payments area is fully in development, it makes sense to focus on that part of blockchain developments in this research project. This focus on payments allows for a bigger impact on this study and allows more flexibility in finding suitable participants, as is desired for this study. Building future outlooks for a specific area will allow for more depth in possible futures and strategic planning. This depth will provide much more academic and managerial added value, in terms of quantification of future uncertainties, advantages, and barriers.

Moreover, as Chang et al. (2020) described, financial institutions, organizations such as market providers (financial service providers), and banks, are constantly performing transactions with each other due to the activities of market participants. Making a transactional (payments) environment a natural scenario for the application of blockchain, as a network is naturally occurring, a network that can be supported or even replaced with a blockchain-based system. Due to the high degree of blockchain developments in the payments industry, the entry of barrier gets lowered in this domain of finance. More resources and energy are dedicated to blockchain for payments projects, as can be seen in the development paragraph 1.1.4. These developments are leading to more initiatives, resulting in the first real-world implementations of blockchain within the financial sector, and will probably be a front-runner in large-scale diffusion of blockchain. By focusing on the payments industry and the perspective of financial institutions, the future outlooks can create more impact in academia and corporate knowledge gaps by contributing to the current and future activities in the payments industry and driving future research in line with industry developments.

Furthermore, not every knowledge gap can be addressed in this research project. The knowledge gap in new financial products and services is out of scope. This knowledge gap is difficult to answer when looking into possible future outlooks of blockchain in the payments industry, as looking into future outlooks is demanding a macro view. The gap in new and financial products and services will demand a micro view

as well. Activities and processes in the payments industry need to be analyzed in detail to determine what can be improved or even abolished with new products and services. This knowledge gap can be addressed in future research.

1.2.3 Scientific, Societal, and Managerial Relevance

Blockchain technology is quickly developing in various forms and applications, due to numerous activities from developers in the blockchain world and the interest which is spreading across industries. From a societal, academic, and managerial perspective, this status quo is making blockchain advantages and applications harder to comprehend and increases the uncertainties for public perception, further research, and corporate endeavors.

Scientific Relevance
The interest in blockchain from an academic perspective is continuously increasing. A dedicated academic field for blockchain started when the blockchain application of Bitcoin was coined in 2008 (Gan et al., 2021). However, blockchain research for the financial sector is an emerging field of study (Osmani et al., 2021). This premature field of literature describes the various advantages and potential applications of blockchain for the financial sector. On the other hand, the literature also presents quite some barriers that need to be surpassed before large-scale diffusion of blockchain can occur in finance. If the domain of finance is neglected, a wider and slightly more evolved field of research emerges. As Zhao et al. (2016) summarized, many blockchain projects are emerging, as presented in Figure 1. Nevertheless, it does not take the fact away that blockchain research is in its infancy.

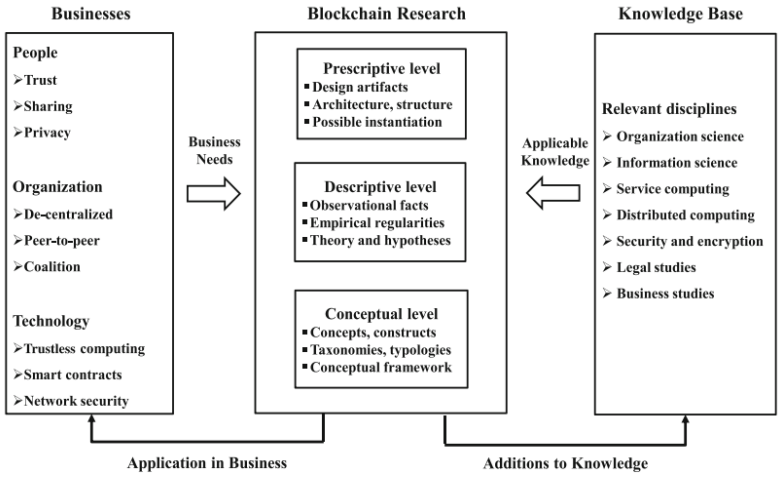

Figure 1: High-level overview of current academic field of blockchain research (Zhao et al., 2016, p. 4)

The current state of blockchain research provides a good understanding of blockchain, describes the advantages and potential applications in traditional finance and banking, and is critical of the barriers. However, an outlook on the future is missing in the academic literature, as is guidance on how to tackle the future uncertainties linked to blockchain diffusion in the payments industry. This research project can help with defining how disruptive blockchain can be and which paths to take to certain future outlooks of blockchain in the payment industry.

Societal Relevance
From a societal perspective, understanding the underlying technology behind cryptocurrencies might help with breaking the image problems of scandals, fraud, or scams. As previously described, the general public is one of the stakeholders of blockchain adoption. Society needs to be involved in what the potential implications of blockchain adoption are for their financial situation if there are any for society. Hence, a societal perspective on blockchain future outlooks in the payments industry is taken into account in this research project.

Managerial Relevance
Lastly, the managerial implications of blockchain are very significant. As presented in 1.1.4, blockchain experimentation and development are being conducted by financial actors, especially in the payments

industry. Examples are mentioned such as privately owned laboratories, the R3 consortium, and various collaborations. Nevertheless, blockchain adoption will be very costly and with so many uncertainties for its future, organizations are hesitant to invest the necessary resources for large-scale diffusion. There is no clear direction or use case with a sound business model. This has been noted as one of the hurdles in blockchain development, other technologies such as AI and RPA are given a higher priority for resources allocation due to their better business case.

In this research project, technology forecasting sheds light on possible future outlooks of blockchain in the payments industry for financial institutions. These outlooks put the advantages, uncertainties, and barriers of blockchain in more perspective. Strategic planning provides a better understanding of the resources that are needed to reach the possible future outlooks of blockchain that are developed in this research project. A combination of technology forecasting and strategic planning in the domain of blockchain in the payments industry is truly a novel piece of work.

1.3 Research Objectives

The described problems are addressed in the research project by researching possible future outlooks of blockchain for the financial sector. This research project can provide guidance to the wild west of growing theoretical blockchain applications in the academic field, practical guidance to executives and managers who are involved with blockchain development, and perspective for society, including governments and public organizations, such as regulators. The guidance and perspective can be defined through strategic planning. Planning that can be used by financial institutions to navigate to a favorable future. As identified in the financial taxonomy, paragraph 1.1.2, financial institutions are organizations such as market providers and banks. They are offering to connect market participants. Blockchain can have the biggest and earliest impact on financial institutions as blockchain is a natural application area in their operational activities. Furthermore, due to the wide spread of opportunities and developments of blockchain in the financial sector, further scoping was necessary, as presented in paragraph 1.2.2. This research project is delineated from the entire financial sector to the payments industry.

Therefore, the main research objective of this research project is *building future outlooks of blockchain in the payments industry and developing a strategic planning for financial institutions.*

Last but not least, the research project needs to be successfully completed for partial fulfillment of the requirements for the degree of Master of Science in Management of Technology. The final deliverable must contain analytical components, is multidisciplinary in nature, focus on a technical application or domain, show the understanding of technology as a corporate resource, and uses scientific methods and techniques as put forward in the Management of Technology curriculum (TUDelft, 2022; Verburg, 2022).

1.4 Research Approach

This study utilizes a combined approach from the fields of technology forecasting and strategic planning. The methods which form the backbone of the research approach are scenario-based roadmapping, combining the research methods of scenario planning and technology roadmapping. Scenario planning helps to explore possible future outlooks. The future outlooks should be plausible, yet not assured. Roadmapping helps with anticipating future needs. When combining these methods, the best of both worlds can be combined (Strauss & Radnor, 2004). Nevertheless, this endeavor takes careful design and implementation. Detailed information regarding which specific methods are applicable and selected for this study are discussed in detail in chapter 2.

1.5 Research Questions

Research questions are defined for obtaining knowledge, aimed at reaching the objectives that are previously mentioned. One main question is formulated and subsequent sub research questions (SRQs) are developed in order to break down the main research question into comprehensible parts.

The **main research question** which will be addressed in this research project is; *Which strategies are available to remain competitive in the blockchain-based future?*

The objective of this research project is to build future outlooks of blockchain in the payments industry and develop strategic planning for financial institutions. The future outlooks will show possible images of where blockchain development could head, thus outlooks to a blockchain-based future. Strategic planning will identify possible strategic pathways towards those possible future images. Financial institutions can use these outlooks and pathways in their favour by steering their strategy towards environmental developments regarding blockchain in the payments industry. These findings will allow financial institutions to remain competitive in a blockchain-based future. Hence, answering the main research question creates insights by which financial institutions can develop their blockchain endeavors in the future.

SRQ1: *What is a suitable methodology of scenario planning that can develop qualitative blockchain scenarios for the financial sector in the payments industry?*

Scenario planning is necessary to create possible futures of blockchain in the payments industry. The academic field of scenario planning is quite evolved and has many different methodologies to offer. Finding a suitable methodology is necessary as a good foundation for this research project. An identified knowledge gap is that empirical evidence on real-world implications is missing in the literature. Utilizing professionals from the financial sector will provide more empirical evidence that can shed light on matters that are not discussed in the literature. Hence, the chosen method must be qualitative. Furthermore, there are various forms of methodologies for different use cases, for example, one specific product, a technology, one organization, or a whole industry. Therefore, the specification in this sub research question regarding the payments industry is necessary. Answering this sub research question will result in a good foundation for this research project. This foundation provides the necessary steps to reach the objectives and main research question.

SRQ2: *What are the contextual variables that impact the current state and future of blockchain in the payments industry?*

To understand this sub research question, the terminology of contextual variable needs to be discussed. First, "Information on the organization and its environment – that is, the contextual factors" (Sekaran & Bougie, 2016, 37). Second, "a contextual variable is a variable that is constant within a group, but which varies by context" (Writer, 2021). Contextual variables are used in business research, sociology, statistics, and information technology (Writer, 2021). The sub research question is aimed at understanding what moves the direction of blockchain development in the payments industry. To pursue this goal, a very select environment will be studied in which this research project will be built utilizing a literature review. Once the context is changed, for example, to sub-branches or very specific activities of the payments industry or other financial domains, variables might vary. Nevertheless, answering this sub research question (SRQ2) is crucial in providing an understanding of the driving factors in blockchain for the payment industry. The knowledge that is necessary to develop possible future scenarios of blockchain for the payment industry.

SRQ3: *What are possible scenarios of blockchain for the payments industry?*

Significant trends in blockchain in the payments industry are determined by answering the previous sub research question. This obtained knowledge is one of the building blocks for scenario planning, enabling to determine what the possible scenarios of blockchain in the payments industry can be. Answering this sub research question (SRQ3) directly contributes input to answering the main research question and the first part of the research objective. The answer to SRQ3 will be the future outlooks of blockchain in the payments industry, namely scenario narratives.

SRQ4: *Which strategic pathways prepare financial institutions in the payments industry to address blockchain development?*

Exploring paths that financial institutions can follow in the payment industry regarding blockchain is the final step to gather all the necessary knowledge to answer the main research question and reach the objective of this research project. With the developed scenario narratives, a strategic plan can be developed for financial institutions to reach them or a combination between them. This strategic plan

is based on this evaluation of the scenarios, data that contributed to development of the scenarios and the reviewed literature. The strategic plan shows what the paths are that can be taken within the scope of this research project. Based on this strategic plan, financial institutions can prepare themselves for the future outlooks and external development that are linked to these outlooks. Hence, answering this sub research question (SRQ4) integrates the results of into a strategic plan, directly contribute input for answering the main research question and reach the second part of the research objective.

1.5.1 Research Flow Diagram

A research flow diagram is a blueprint for the collection, measurement, and analysis of data, created to answer (sub) research questions, presented in Figure 2 (Sekaran & Bougie, 2016). This diagram is a visual overview of the (sub) research questions and their deliverable(s), connected to their respective research methods.

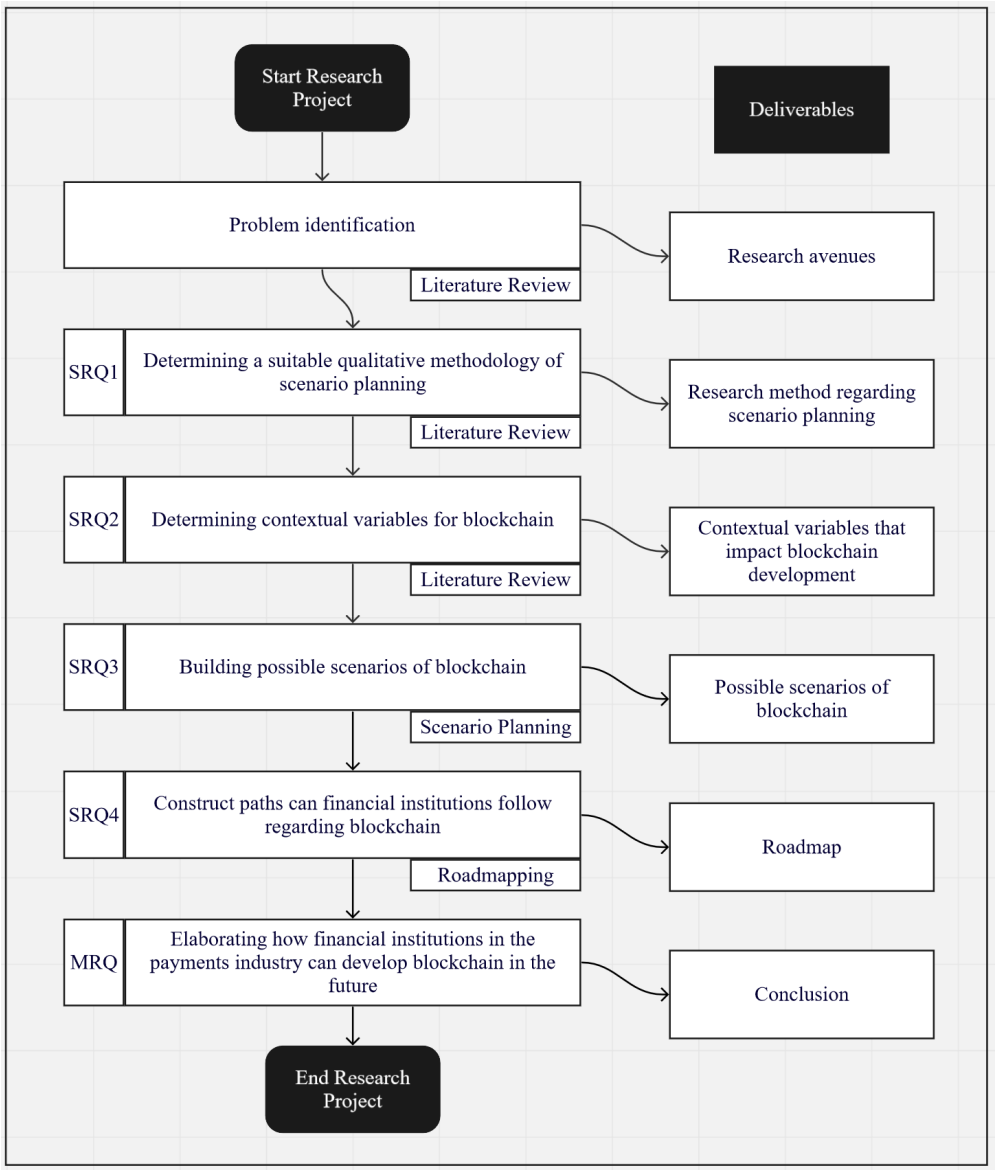

Figure 2: Research flow diagram

1.6 Thesis Overview

This research project is characterized by four sub research questions. Ideally, each sub question has a dedicated chapter. This entails that the thesis consists of six chapters, one chapter for the introduction, one chapter for the conclusions, and four chapters dedicated to each sub research question. The first chapter has set the foundation of this research project. Chapter two focused on determining a suitable qualitative scenario planning methodology. The evolutionary path of scenario planning is presented and with a funneling technique, a suitable method is found. Chapter three takes a deep dive into the driving factors that make the blockchain world go round, but also hold the blockchain developments back. In the fourth chapter, a scenario workshop is hosted with international experts from the academic and professional fields. They participated in building possible scenarios of blockchain in the payments industry from the perspective of financial institutions. Moving on to the fifth chapter, roadmapping activities are presented and conducted. First, starting with evaluating the scenarios. Second, construct pathways to reach the scenarios. Third, identifying flex points, pivotal points in the roadmap that can create shifts in the roadmap. Fourth and last, a multi-scenario roadmap is presented. The final chapter, number six, offers the conclusion, limitation of the research, future research, and an MoT master program reflection. A sneak peek towards the end, this research can become part of the start of a new branch in the academic field of blockchain in the financial sector. So, as described in this section, the next chapter enters the domain of scenario planning.

2 Research Approach

This chapter is the foundation of how the research project will be conducted, hence the chapter name research approach. The relevant technological forecasting and strategic planning methods are reviewed, compared, and a suitable one is chosen. In doing so, this chapter answers sub research question 1 (SRQ1). This research question, "What is a suitable methodology of scenario planning that can develop qualitative blockchain scenarios for the financial sector on the payments industry?" will determine how possible future outlook will be developed. The answer provides a methodological approach for qualitative research in this research project. Besides, information from the course "MOT2312 Research methods" will be reviewed in this chapter, the first direct link to the MoT program. Scientific research characteristics will be taken from the course and linked to the chosen technological forecasting and strategic planning methods.

2.1 Scenario-based Roadmapping

This paragraph discusses what type of technological forecasting and strategic planning methods are used in this research project.

2.1.1 Search Process and Selection Criteria

To get a grasp of the literature in the field of technology forecasting and scenario planning, the following keywords were used in the search process; (Future OR Futures) AND (Forecasting OR Forecast OR Foresight) AND (Scenario OR Scenarios). This resulted in 9.955 and 5.893 hits in Scopus and WoS, respectively. To get better and more focused search results, the journals were limited, as the goal were to get papers on technology forecasting and research methods for scenario planning. The search was limited to to the following journals; Technological Forecasting and Social Change, Foresight, Futures, Journal of Futures studies, European Journal of Futures Research, International Journey of Foresight and Innovation Policy, International Journal of Forecasting, Long Range Planning, and Foresight and STI Governance. This limitation resulted in 484 and 454 hits in Scopus and WoS, respectively. From this selection, the 100 highest cited papers were scanned (reading titles and abstracts quickly) for relevance, as the goal was to get a grasp of the literature field. This will help with the objective of obtaining a general understanding of technology forecasting and scenario planning and find suitable research methods.

Most of the results were connected to a very specific method of scenario planning or specific applications and case studies. For example, some methods of scenario planning where only focused and specialized for climate change cases, some were purely focused on the long-term validity and strategic management implication, and some were linked to modelling approaches and specific methods such as the cross impact analysis. As the goals was to get a holistic and broad overview of the technology forecasting and scenario planning field, a selection has been made, based on excluding the specific methods, applications, and case studies. Limiting the results to only the highest 100 cited papers, helped to find promising papers with a holistic and broad overview. Papers were skimmed to gather possible scenario planning methods, preferably with a link to strategic planning. Skimming or skim reading is a technique to get an understanding of what is proposed in an article. Skimming entails reading quickly to get a grasp of the main points in an article, but skipping the details (Jesson et al., 2011). Promising papers were usually literature reviews, evolutionary development papers or practical/ methodological guidelines on how to pick a research method in the field of technology forecasting and scenario planning. The process has been visualized in Figure 3 and the final selection is presented in Table 3. Each promising paper that is selected for usage in this chapter provides new knowledge to obtain a broad knowledge on various scenario planning methods. If a promising paper contains knowledge that significantly overlaps with another paper that already is reviewed, it will not be taken into account.

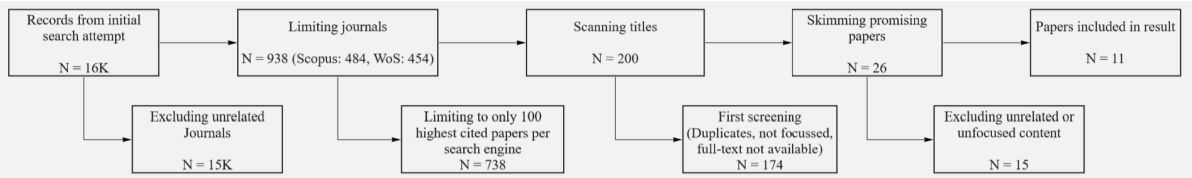

Figure 3: Search process for scenario planning

Author(s)	Year	Title
Amer et al.	2013	A review of scenario planning (Amer et al., 2013)
Bradfield et al.	2005	The origins and evolution of scenario techniques in long range business planning (Bradfield et al., 2005)
Coates	2000	Scenario Planning (Coates, 2000)
Gordon et al.	2020	50 Years of corporate and organizational foresight: Looking back and going forward (Gordon et al., 2020)
Huss & Hunton	1987	Scenario Planning- What Style Should You Use? (Huss & Honton, 1987)
Huss	1988	A move Towards Scenario Analysis (Huss, 1988)
Martino	2003	A review of selected recent advances in technological forecasting (Huss, 1988)
Rohrbeck et al.	2015	Corporate foresight: An emerging field with a rich tradition (Rohrbeck et al., 2015)
Schnaars	1987	How to Develop and Use Scenarios (Schnaars, 1987)
van der Heijden	2000	Scenarios and Forecasting: Two Perspectives (van Der Heijden, 2000)
Notten et al.	2003	An updated scenario typology (van Notten et al., 2003)
Varum & Melo	2010	Directions in scenario planning literature – A review of the past decades (Varum & Melo, 2010)

Table 3: Table with reviewed literature for scenario planning

2.1.2 Technological Forecasting

Before diving into the literature, an overview of the funneling steps of this chapter section is provided in Figure 4. Technological forecasting is an established field of research, existing for over 50 years. As Martino (2003) mapped, there are various methods that can be used in technological forecasting, some prominent methods that are used in this academic field are; environmental scanning, models, scenario planning, Delphi, extrapolation, probabilistic forecasts, technology measurement and chaos theory. Some of these methods cross-over in each other as is shown in the paper of Schnaars (1987). This paper considers the Delphi method as a means to build scenarios, besides various other scenario planning methodologies. More on this discrepancy in paragraph 2.1.3.

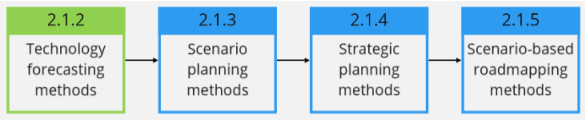

Figure 4: Research approach - technology forecasting

As mentioned in the introductory chapter, there are some knowledge gaps in the current literature. These knowledge gaps are where blockchain development will be heading, unclear which financial application should be developed first, and the need for empirical evidence on real-world implications of blockchain-based futures. The last gap is guiding the research into a qualitative area. To collect data that provide real-world implications, professionals from the academic and corporate fields need to participate in this research project. Qualitative data collection methods such as interviews, questionnaires, focus groups or expert panels are necessary to collect such data (Sekaran & Bougie, 2016).

Taking this qualitative nature and other knowledge gaps into consideration, the research project is being guided towards environmental scanning and scenario planning (inc. Delphi). First, these are methods that are primarily based on a qualitative base, nevertheless, these methods also come with a quantitative base. Yet, other methods, such as models, extrapolation, probabilistic forecasts, technology measurement, and chaos theory require a certain amount of data to result in satisfactory forecasts with enough depth and accuracy. This data is not available due to the premature state of research. Second, the knowledge gaps; where blockchain development will be heading and unclear which financial applications should be developed first are in line with the main purpose areas of scenario planning, as Bradfield et al. (2005) defined; making sense of a particularly puzzling situation, developing strategy, and anticipation.

Environmental scanning can also be crossed off the list, as this method is based on that technological change regularly follows a standardized sequence of steps. The introductory chapter presented more than enough reasons why blockchain is certainly not following a standardized sequence of technological change. The technology has expanded in development and market value to unprecedented heights in a relatively short amount of time. Due to this fast pace in development and value, this technology will change like no other due to barriers that have not yet been encountered in this proportion and configuration, such as the image problems by society and increasingly growing attention by financial regulators.

The scenario planning method is a proper research method for this research project. As van Der Heijden (2000) added, a proper scenario approach helps to negotiate the trip to possible futures more efficiently. Scenario planning can achieve this result by identifying possible futures with plausible occurrences, yet not assured (Schnaars, 1987). The principle of scenarios lies in exploiting a group and their combined intuitive knowledge of a particular situation (van Der Heijden, 2000). Moreover, as Martino (2003) noted, scenario planning can be used in combining related but separate forecasts, if those forecasts bear on some topic of interest. This can be very interesting for the scope of this research project because the possible scenarios for the payments industry should have relating connections. The possibility of combining the scenarios can enhance the value of the strategic planning as the best of multiple scenarios can be merged. In doing so, the scenarios can sketch an overall picture of the scoped environment, as opposed to single segments of the scoped environment captured by each scenario. The characteristics of scenario planning are described in the literature as (Huss, 1988; Martino, 2003);

- Establishing interactions between events and trends to sketch a holistic picture of a possible future;
- Depicting possible futures in an understandable way by a non-expert in the field of study, promoting to solve the problems in society;
- Incorporating qualitative input in a systematical way;
- providing a comprehensive analysis of the scoped environment in a macro view;
- Guiding towards identifying possible tipping points, if not, predicting them;
- serving as a (internal) communications tool;
- providing a bridge in order to link the possible forecasts to a decision-making process.

As previously mentioned, the field of technological forecasting is quite established. As Huss (1988) noted as one of the early prominent papers in the field, scenario planning was first applied to corporate planning and technology forecasting by Herman Kahn at the RAND Corporation in the 1950s. Scenarios were primarily utilized in military and strategic studies. Many years later, corporate scenario planning lead to interesting papers and forecasts. For example, in 1971, General Electric published the scenario analysis; 'Four Alternative World/U.S. Scenarios' and Shell began with scenario analysis in the early 1970s, these scenarios assisted Shell in preparations for the oil crises of 1973-1974 and 1979. A study on the topic by Rohrbeck et al. (2015) presented an evolutionary development figure of the corporate foresight research field in the light of scenario planning presented in Figure 5. Technological forecasting has been covered in multiple fields of research in the past and still is scattered in academics, examples of some fields are; (corporate) foresight, future studies, and corporate planning.

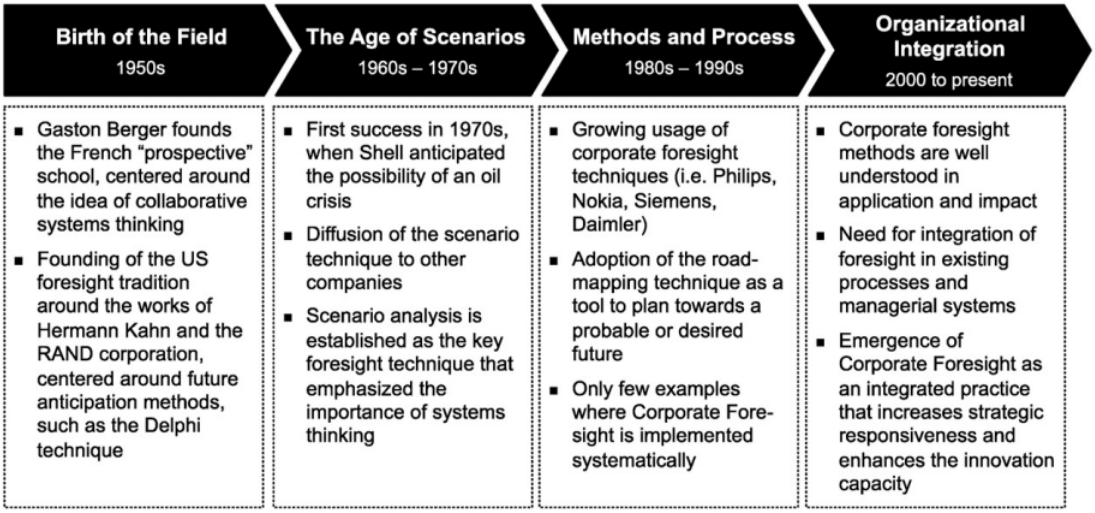

Figure 5: Overview of scenario development in technological forecasting (Rohrbeck et al., 2015, p. 4)

2.1.3 Scenario Planning Methods

This paragraph focuses on the chosen technology forecasting methods, namely, scenario planning. As shown in Figure 6.

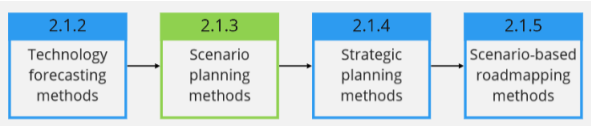

Figure 6: Research approach - scenario planning

There are numerous types of scenario planning methodologies in the academic field of technology forecasting. As Amer et al. (2013) classified, there are certain types of scenario planning methods, such as Continued growth, Collapse, Steady state, or Transformation, describing to what extent the scenarios are disruptive. Furthermore, the literature field has indicated some prominent scenario planning methodologies, as presented in Table 4.

Qualitative	**Quantitative**
Intuitive logics methodology (Huss, 1988; Bradfield et al., 2005; Amer et al., 2013), also known as SRI international (Huss & Honton, 1987)	Interactive Cross Impact Simulation (INTERAX) (Huss & Honton, 1987; Huss, 1988; Bradfield et al., 2005; Amer et al., 2013), also known as (SMIC)
La prospective methodology (Coates, 2000; Bradfield et al., 2005; Amer et al., 2013), has qualitative and quantitative aspects	Probabilistic modified trends (Bradfield et al., 2005; Amer et al., 2013)
Delphi (Schnaars, 1987; Sekaran & Bougie, 2016)	Interactive Future Simulations (IFS) (Amer et al., 2013)
-	Trend impact analysis (TIC) (Huss & Honton, 1987; Huss, 1988; Amer et al., 2013)
-	Fuzzy Cognitive Map (FCM) (Amer et al., 2013)

Table 4: Prominent scenario planning methodologies

Such a rich field of various methodologies makes it complex to pick the right scenario planning methodology for a given situation. However, one thing has already been decided, a qualitative approach must be taken because there is not enough data to perform a proper quantitative analysis and high uncertainty makes quantitative methods less accurate. The paper of van Notten et al. (2003) described 14 scenario method characteristics, categorized in three overarching themes, as visualized in Figure 7. Based on these

scenario planning method characteristics a suitable scenario planning method can be selected.

Overarching themes		*Scenario characteristics*	
A	Project goal: exploration vs decision support	I.	Inclusion of norms? : descriptive vs normative
		II.	Vantage point: forecasting vs backcasting
		III.	Subject: issue-based, area-based, institution-based
		IV.	Time scale: long term vs short term
		V.	Spatial scale: global/supranational vs national/local
B	Process design: intuitive vs formal	VI.	Data: qualitative vs quantitative
		VII.	Method of data collection: participatory vs desk research
		VIII.	Resources: extensive vs limited
		IX.	Institutional conditions: open vs constrained
C	Scenario content: complex vs simple	X.	Temporal nature: claim vs snapshot
		XI.	Variables: heterogeneous vs homogenous
		XII.	Dynamics: peripheral vs trend
		XIII.	Level of deviation: alternative vs conventional
		XIV.	Level of integration: high vs low

Figure 7: Overview of scenarios planning method characteristics (van Notten et al., 2003, p. 426)

Project Goal

The knowledge gaps of where blockchain development will be heading and unclear which financial application should be developed first need to be addressed in this research project. To provide sufficient knowledge for both gaps, exploration is necessary to determine what the possibilities are in future development and applications. Exploration is linked to descriptive and forecasting scenarios (van Notten et al., 2003). Further, the objective of this research project is to build future outlooks of blockchain in the payments industry. Blockchain can be seen as issue-based and the payments industry as institution-based. The payments industry is not geographically specified, it is viewed from a global perspective (spatial scale). Lastly, the time scale has yet been undefined. Scenario planning is usually focused on the long term, however, there is no evidence that scenarios are not suited for shorter horizons (Schnaars, 1987). The reviewed literature on blockchain provided various predictions for blockchain in 2030. A horizon to 2030 seems like a good period, as most information used in this research project is based on the reviewed literature. This entails a short-term view, short-term is 3-10 years according to van Notten et al. (2003).

Process Design

As previously discussed, the research project takes a qualitative approach, gathering empirical evidence on real-world implications. This is necessary for obtaining knowledge to tackle one knowledge gap related to the lack of empirical evidence in the literature. The process design theme can take an intuitive or formal approach. The desired scenario planning method is leaning strongly against the intuitive side as that is characterized by qualitative data and participatory data collection. The formal approach is linked to the La prospective approach. the intuitive approach is linked with the Delphi and Intuitive logic method. Furthermore, this research project has limited resources and has open institutional conditions.

Scenario Content

According to van Notten et al. (2003) scenarios can be complex or simple. Complex scenarios are characterized by "an intricate web of causally related, interwoven, and elaborately arranged variables and dynamics" (van Notten et al., 2003, p. 428). Also recognizable by multi-problem, multi-dimensional and multi-scale conditions. The scenarios for blockchain in the payments industry will be complex scenarios since there are interwoven problems in the areas of barriers (paragraph 3.2.2) and multi-dimensional as various disciplines are necessary to evaluate (e.g. technical, regulatory, societal, and organizational). Further, scenarios can have a chain or snapshot nature. The chain can be compared with a film and a snapshot with a photo, given the limited resources, snapshot scenarios are desired. The nature of the variables will be heterogeneous as various variables cannot be clustered or themed together as homogeneous variables. All possible future outlooks are desired, and unlikely and extreme events are welcome in this research project. These are characterized as peripheral scenarios, the opposite of this is trend scenarios, also known as surprise-free scenarios. Peripheral scenarios are also linked to alternative scenarios. Lastly, the level of integration is high because the interaction between the variables and dynamics is desired. This is necessary to analyze the scenarios after building them. If the level of integration is low, the

interconnections between the scenarios are low.

Chosen Scenario Planning Method

With the desired scenario planning methods characteristics defined, the qualitative scenario planning methods have something to compare with, as presented in Figure 8. The La prospective method will not be chosen based on the differences between the desired characteristics shown in Figure 8. One of the major arguments for not using La prospective is given its quantitative nature, which is not desired in this research project. The difference between the Intuitive logics method and the Delphi method is minimal. The Intuitive logics method is chosen as scenario planning method in this research project, based on the limited resources, incorporation of desk research, and short-term scale that the Intuitive logics method provided in contrast to the Delphi method, as depicted in 8.

Themes	Characteristics	Desired	Intuitive logics	Delphi	La prospective
		Explorative	**Explorative**	**Explorative**	**Explorative**
Project goals	Norms	descriptive	descriptive	descriptive	descriptive
	Vantage point	forecasting	forecasting	forecasting	forecasting
	Subject	Issue/ Institution	-	-	-
	Time scale	short	short/ long	long	short/ long
	Spatial scale	global	-	-	-
		Intuitive	**Intuitive**	**Intuitive**	**Formal**
Process design	Data	qualitative	qualitative	qualitative	qualitative/ quan...
	Data collection	desk/ participatory	desk/ participatory	participatory	desk/ participatory
	Resources	limited	limited	limited/ extensive	extensive
	Institutional	open	-	-	-
		Complex	**-**	**-**	**-**
Scenario content	Temporal nature	snapshot	-	-	-
	Variables	heterogeneous	-	-	-
	Dynamics	peripheral	peripheral	peripheral	trend
	Deviation	alternative	alternative	alternative	conventional
	Integration	high	high	high	high

Figure 8: Comparison of qualitative scenario planning methods based on Martino (2003); van Notten et al. (2003); Amer et al. (2013); Sekaran & Bougie (2016).

This chosen scenario planning method focuses on exploring what could occur in the future and determine the most plausible one. However, scenario planning does not provide sufficient guidance on how to get to that plausible future. Strategic planning can assist in this endeavor. The next paragraph discusses the connections of scenario planning to strategic planning.

2.1.4 Scenario Planning in Strategic Planning

This paragraph focuses on the links of strategic planning to scenario planning, as presented in Figure 9.

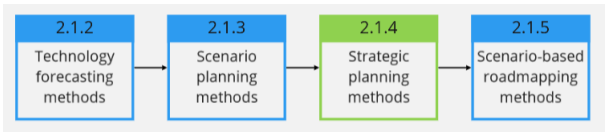

Figure 9: Research approach - strategic planning

The paper of Gordon et al. (2020) presented an overview of the developments in the last 50 years regarding technology forecasting, as presented in Figure 10. In the last two decades, technology roadmapping has been introduced into the field of technology forecasting and continues to develop. There is a need for this roadmapping in the field of technological forecasting.

Search Process and Selection Criteria
To find relevant literature regarding roadmapping in technology forecasting and scenario planning, the following keywords were used in the search process; ("Strategic Planning" OR "Strategic Management") AND ("Road Mapping" OR "Roadmapping" OR "Road map" OR "Roadmap") AND (Scenario OR Scenarios), resulting in 57 and 29 hits in Scopus and WoS, respectively. Most of the results were connected to a very specific research method or specific applications and case studies, as was the case in the first round

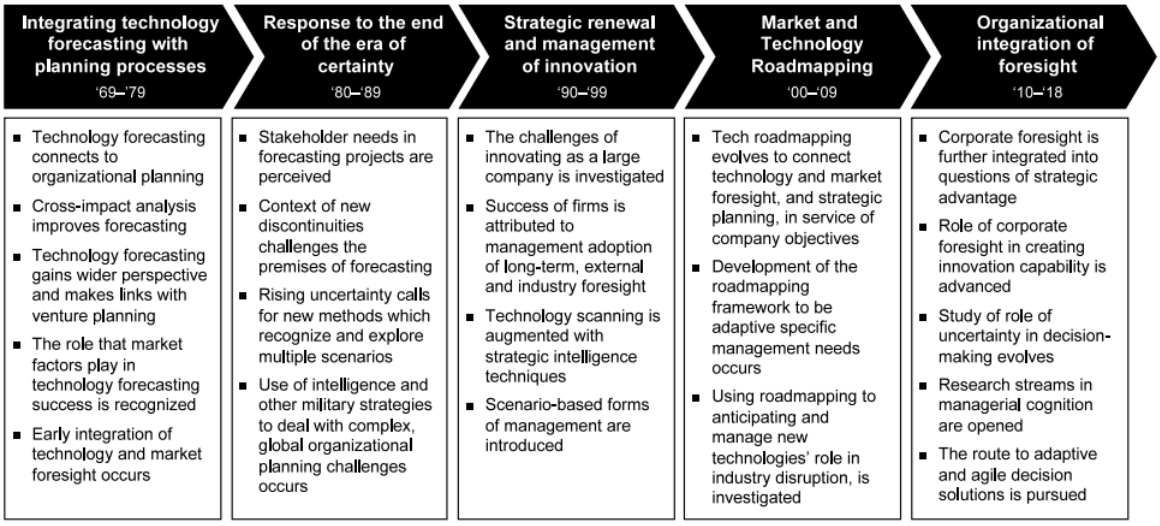

Figure 10: Developments of technology forecasting in the last 50 years (Gordon et al., 2020, p. 8)

of literature search, described in paragraph 2.1.1. As a result of this exclusion, 13 papers seemed relevant at first scanning, 5 of the 13 papers were doubles, resulting in 8 usable papers ready to be skimmed in more detail. After detailed skimming, 3 papers were excluded due to specific focus and low relevance to the combination of roadmapping in technology forecasting and scenario planning. However, an additional paper has been considered relevant due to snowballing, finally resulting in 6 suitable papers, presented in Table 5. Papers from this search attempt are used in the following paragraphs. Images of the search results can be viewed in Figure 11.

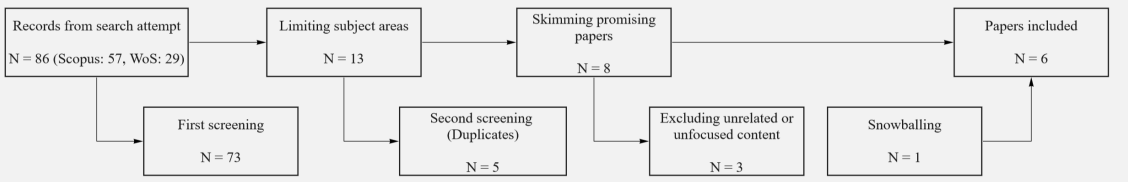

Figure 11: Search process for roadmapping literature

Author(s)	Year	Title
Carvalho et al.	2013	An overview of the literature on technology roadmapping (TRM): Contributions and trends (Carvalho et al., 2013)
Cheng et al.	2016	A scenario-based roadmapping method for strategic planning and forecasting: A case study in a testing, inspection and certification company (Cheng et al., 2016)
Strauss & Radnor	2004	Roadmapping for Dynamic and Uncertain Environments (Strauss & Radnor, 2004)
Valerio et al.	2021	Overview on the technology roadmapping (TRM) literature: gaps and perspectives (Valerio et al., 2021)
Vinayavekhin et al.	2021	Emerging trends in roadmapping research: A bibliometric literature review (Vinayavekhin et al., 2021)
Vishnevskiy et al.	2016	Integrated roadmaps for strategic management and planning (Vishnevskiy et al., 2016)

Table 5: Table with reviewed literature for Roadmapping

Roadmapping
Roadmapping is an increasingly growing method in the field of strategic planning and is currently widely used (Vishnevskiy et al., 2016; Valerio et al., 2021). Roadmapping is viewed in the literature as a powerful approach in strategic planning due to its usefulness, flexibility, and simplicity (Vishnevskiy et al., 2016; Vinayavekhin et al., 2021). Its popularity is increasing because roadmapping incorporates analyzing connections among multiple factors such as technologies, markets, services, resources, and products (Cheng et al., 2016; Vinayavekhin et al., 2021). Additionally, utilizing visual tools (the roadmap), mobilizing structural systematic thinking, addressing organizational opportunities and challenges, supporting communication, and aligning innovation management and strategic planning (Vinayavekhin et al., 2021). The mentioned elements are better understood with roadmapping, presented in a flexible layout, and aligned with a timeline to achieve defined goals (Strauss & Radnor, 2004; Cheng et al., 2016). These characteristics of roadmapping allow an organization to anticipate future needs.

In Figure 10, roadmapping is presented as a relative new method. The literature on roadmapping noted that the method has been used for about three decades before academics developed an interest in it (Vinayavekhin et al., 2021). The first documented use case described in the literature is an industrial roadmapping practice first developed by Motorola in the 1960s (Carvalho et al., 2013; Vishnevskiy et al., 2016; Vinayavekhin et al., 2021). Thereafter, other use cases have been identified in other large technological-based organizations such as Philips, EIRMA, General Motors, Lockheed Martin, Intel, and the Semiconductor Industry Association (Vishnevskiy et al., 2016; Vinayavekhin et al., 2021). The paper of Vishnevskiy et al. (2016) distinguished that the first industrial roadmapping practices were developed during the 1970s, and a significant academic methodological method was achieved during the 2000s by Rob Phaal with the 'T-plan', a fundamental framework for roadmapping.

Roadmapping has certain issues, as Strauss & Radnor (2004) identified, there are gaps in foresight and knowledge regarding future events or conditions. Another issue identified by the paper is the lack of presentation and communication of contextual and underlying factors related to the roadmap. Scenarios seem like a good fit to cover these issues.

Scenario-based Roadmapping
As scenario planning is already chosen as a suitable research method to cover knowledge gaps in the current field of blockchain in finance, roadmapping can be used to further strengthen the scenario planning process. The knowledge gaps are where blockchain development will be heading and what should be developed first, for example as low-hanging fruit or a path of least resistance. In scenarios, both knowledge gaps will be covered, however, not in an equal distribution. The scenarios will describe possible future blockchain developments and these will be evaluated. These activities are mainly focused on the first gap. Roadmapping can assist with focusing on the second gap, by looking into the path (roadmap) of getting to a possible and plausible future.

The literature described some hybrid forms of roadmapping, incorporating multiple research methods to compensate for their limitations. Roadmapping has been combined with relatively simple methods such as SWOT analysis, but also with technological forecasting methods such as the Delphi method (Valerio et al., 2021). The first paper to develop a marriage between scenario planning and roadmapping is Strauss & Radnor (2004), describing the result as "*a carefully designed and implemented blend of scenarios planning and roadmapping can offer the best of both world*" (Strauss & Radnor, 2004, p. 51). This paper proves that combining the two methods is possible, combining macro and high-level thinking with (micro) planning. Blending the two methods requires resolving structural, operational/ strategic, micro/ macro perspectives, and time-horizon variations (Strauss & Radnor, 2004). The next paragraph presents scenario-based roadmapping methods found in the literature.

2.1.5 Scenario-based Roadmapping Methods

This paragraph focuses on the possible scenario based methods that are available in the literature. This is the last step in finding suitable research methods for this research project, as presented in Figure 12.

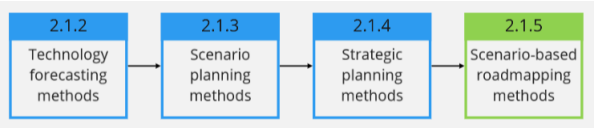

Figure 12: Research approach - scenario-based roadmapping

Given the historical developments in roadmapping, as described in the previous paragraph, there are many types of roadmapping methods in existence due to industrial practices. This resulted in a lack of clear standards for roadmapping (Carvalho et al., 2013). When incorporating another research method into the mix, the situation becomes more complicated. Luckily the literature is transparent in how scenario planning and roadmapping are combined and with which methods as a backbone. As previously mentioned, the paper of Strauss & Radnor (2004) is the first to combine scenario planning and roadmapping, called Multi-scenario roadmapping, a highly iterative process explained in 15 steps.

The paper of Cheng et al. (2016) presented various examples of scenario-based roadmapping methods and use cases. Nevertheless, for the aimed use-case in that paper, there was a need to develop another method. Other methods are presented in the literature, for example, there are methods utilizing the fuzzy cognitive map and Cross Impact Analysis, two prominent scenario planning methods (Vinayavekhin et al., 2021; Valerio et al., 2021). The papers mentioned in this section provide various scenario-based roadmapping methods, with snowballing of the bibliography, some additional methods are found and processed in Table 7.

Search Process and Selection Criteria
To reduce the risk of missing important scenario-based roadmapping literature, one final search attempt is conducted with the following keywords; (Roadmapping OR "Road Mapping") AND ("Intuitive logics"), resulting in 14 and 0 hits in Scopus and WoS, respectively. From those 14 hits, two papers present scenario-based roadmapping methods worth looking into (Pagani, 2009; Hussain et al., 2017). The other 12 hits did not present any new scenario-based roadmapping methods, thus excluded from the selection. Snowballing in the previously selected literature resulted in two other papers that present two new scenario-based roadmapping methods (Hansen et al., 2016; Lee & Geum, 2017).

Author(s)	Year	Title
Hansen et al.	2016	The future of rail automation: A scenario-based technology roadmap for the rail automation market (Hansen et al., 2016)
Hussain et al.	2017	Scenario-driven roadmapping for technology foresight (Hussain et al., 2017)
Lee & Geum	2017	Development of the scenario-based technology roadmap considering layer heterogeneity: An approach using CIA and AHP (Lee & Geum, 2017)
Pagani	2009	Roadmapping 3G mobile TV: Strategic thinking and scenario planning through repeated cross-impact handling (Pagani, 2009)

Table 6: Table with reviewed literature for Scenario-based Roadmapping

Scenario-based Roadmapping methods found in the literature	**Applicability**
Strauss & Radnor (2004)	**No**, this method is considered the first of academic scenario-based roadmapping method in the literature. However, this method is not applicable for this research project due to a different perspective of research. This method is focused on organizational scenario planning. Yet, some characteristics of the used roadmapping approach could be used in this research project, such as flex points in a roadmap. A flex point is a point in the roadmap where adjustments to the direction can be warranted.
Pagani (2009)	**No**, the reason this method came up in the final search attempt with "intuitive logics" in the keywords is that this paper contains a description of the Intuitive logics method as scenario planning method. The scenario planning method used in this scenario-based roadmapping method is primarily based on the cross impact analysis, a quantitative-based method. Not suitable for this research project as it is qualitative-based.
Amer et al. (2016)	**No**, Fuzzy cognitive maps (FCM) are used in this method, as previously described in the overview table of scenario planning methods, FCM is a quantitative scenario planning method. This research project is qualitative-oriented, thus this scenario-based roadmapping method is not applicable.
Cheng et al. (2016)	**No**, at first sight, this method seems eligible. It is qualitative-based and utilized alternative future outlooks. However, the same reasoning from the first scenario-based roadmapping method is applicable here, this method is focused on organizational scenario planning and roadmapping and has a micro view.
Hansen et al. (2016)	**No**, yet, this was a close call. This paper does not create the scenarios but takes them from other scenario planning projects and papers. This would seem a direct No-Go for this research project, however, creating the scenarios can be conducted by using the Intuitive logics method, earlier established in this chapter. The problem is that this paper is not transparent in how it utilizes the scenarios in roadmaps and the roadmaps are primarily based on quantitative-based scenarios. There are also qualitative-based roadmaps, however, these are product-oriented.
Lee & Geum (2017)	**No**, Cross impact analysis (CIA) and analytical hierarchy process (AHP) are used in this method. The scenario planning method used in this scenario-based roadmapping method is primarily based on the cross impact analysis, a quantitative-based method. Not suitable for this research project as it is qualitative-based.
Hussain et al. (2017)	**Yes**, the Intuitive logics method is used in this scenario-based roadmapping method. This is the only research method that uses the Intuitive logics method in combination with roadmapping, with an industry focus. Further, the paper provides a detailed description of how the scenario planning activities are linked to roadmapping, this is often lacking in the reviewed literature. Moreover, this is also one of the few methods that fully utilized the scenario planning method, allowing to take full advantage of the used scenario planning method.
Son et al. (2020)	**No**, Fuzzy cognitive maps (FCM) are used in this method, as previously described in the overview table of scenario planning methods, FCM is a quantitative scenario planning method. This research project is qualitative-oriented, thus this scenario-based roadmapping method is not applicable.

Table 7: Applicability of current scenario-based roadmapping methods

As presented in Table 7, the current supply in scenario-based roadmapping there is one suitable scenario-based roadmapping method, based on the reviewed literature. Search attempts for roadmapping and the Intuitive logics method have resulted in one satisfactory method worth using in this research project.

2.2 Research Design

A scenario-based roadmapping method is chosen in the previous paragraph. This method consists of various steps. This method by Hussain et al. (2017), utilizes the intuitive logics school of scenario planning and combines it with the roadmapping approach utilized by Strauss & Radnor (2004). This roadmapping approach has desirable characteristics such as flex points, enabling to create of a dynamic roadmap and multiple paths to plausible scenarios.

The scenario planning method, intuitive logics method, usually consists of eight steps; analyzing the decisions and strategic concerns, identifying the key decision factors, identifying the key environmental forces, analyzing the environmental forces, defining scenario logics, elaborating the scenarios, analyzing implications for key decision factors, and analyzing implications for decision strategies (Huss & Honton, 1987; Huss, 1988). Yet, the chosen method consists of six steps for scenario planning. The reason for discrepancies in methods is that more recent studies combine certain steps, add steps or leave out steps. As done by experts in the field such as Patrick van der Duin (Bouwman & van der Duin, 2003; Janssen et al., 2007). Steps are often left out if methods are combined, as is the case with scenario-based roadmapping. After further analysis of which derivative of the intuitive logics method is used by Hussain et al. (2017), the book "Scenario Thinking" by Cairns & Wright (2017) came foreword. This is an established method in the field of scenario planning. This analysis was supported by Alessandro Fergnani [1].

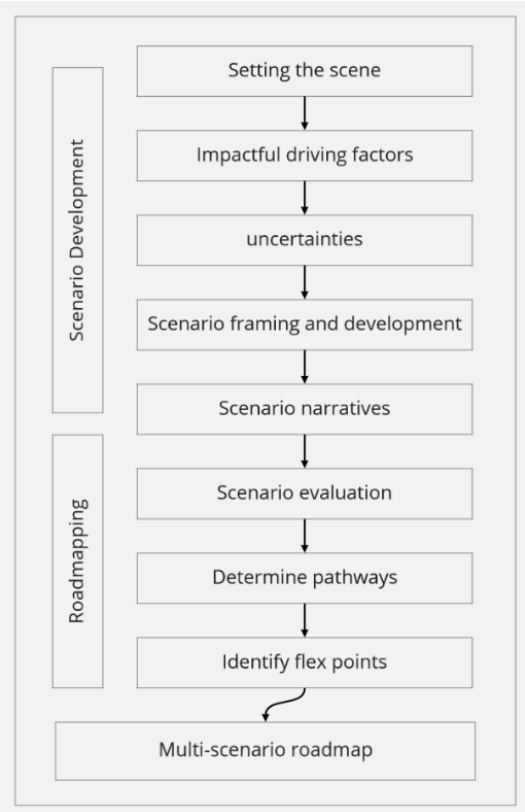

Figure 13: Chosen scenario-based roadmapping method, based on Hussain et al. (2017)

The chosen scenario-based roadmapping method forms the backbone of the research design for this research project. There are two phases, build up in eight steps. The first phase is representing the intuitive logic scenario development and the second phase represents roadmapping based on the scenarios from phase one (Hussain et al., 2017) and the book "Scenario Thinking" by Cairns & Wright (2017). The necessary steps to eventually reach the objective of this study are summarized in Figure 13.

Phase One - Scenario Development

The first step of this research design is called setting the scene. This step entails clarifying the intention of the study, determination of the horizon (time scale), stakeholder mapping, and required knowledge/

[1] PhD researcher and executive educator focusing on futures & foresight at the National University of Singapore.

scoping. Most of these activities have already been touched upon in the introductory chapter. This is a important part of scenario planning, as it creates the environment where this study takes place. The second step proposes that the key driving factors should be identified. Using a framework is recommended by Hussain et al. (2017), such as PEST (Political, Economical, Social, and Technological) analysis or it derivatives.

After identification of the driving factors, the focus is on the uncertainties in step three. Again, the focus is on key uncertainties for the development of scenarios. The chosen method proposes to use an uncertainty/ impact matrix for this endeavor. By using this matrix, the key factors and uncertainties are easier recognizable. Step four can be considered the core activity of scenario planning as the themes (scenario frame) and scenarios will be developed in this step. The literature suggests a cross-impact analysis to check the consistency of the scenario theme, however, this research project has great uncertainty. Thus, using a quantitative approach for this endeavor makes no sense, logical reasoning is used instead. Furthermore, this step is also not described in Hussain et al. (2017), for the use case where this scenario-based roadmapping approach is used. The scenario development in this method follows a deductive approach. The last step of phase one entails creating scenario narratives. There are various ways to create these narratives, nevertheless, this method advises resonating with the users of the scenarios when creating the narratives.

Phase Two - Roadmapping
When the scenario narratives have been developed, the construction of the roadmapping activities can start. First, the developed scenarios need to be evaluated in terms of implications for society, industry, and corporate organizations. Second, pathways toward the scenarios need to be constructed. The needs within each scenario need to be determined in this step. This endeavor is guided by exploring the content of the technology roadmap provided by Hussain et al. (2017). This technology roadmap is an architectural framework in which technology can be explored in various categories and time intervals. The standard time intervals are 1, 3, 10, and vision. This research project aims at 2030, hence the time intervals are 1, 2, 8, and vision. This adapted technology roadmap is presented in Figure 14.

	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties				
Internal Business Strategy				
Product/ Service/ System				
Technology				
Resource				

Figure 14: Technology Roadmap provided by Hussain et al. (2017)

The external market/ uncertainties are provided by the outputs of the scenario development phase. This utilization of previous results, therefore, serves as a key link between the two phases of this research method. Once the architectural framework of the technology roadmap is explored, pathways can be constructed with the contents. Once the pathways of the scenarios are developed, identification of the "flex points" can start. Flex points are key potential developments in the environment of the study. These potential developments could have a significant impact on the evolution of the technology (Hussain et al., 2017). During the identification of the flex points, the following question is essential to keep in mind: "what would need to happen for each scenario to take place?" (Hussain et al., 2017, p. 170). The uncertainties part from the scenario development phase can be used to guide the identification of the flex points, this increases the internal consistency of results. Once the pathways are done and flex points are identified, a multi-scenario roadmap can be created. This roadmap shows various routes to different future outlooks and pivotal points which allows for shifts in strategy over time. Using a multi-scenario roadmap is deviating from the roadmapping approach described in Hussain et al. (2017). However, it is used as an addition, not as a fundamental change of the roadmapping activities. A multi-scenario roadmap is proposed by Strauss & Radnor (2004), a paper that has been recognized by Hussain et al. (2017), for the identification of flex points.

2.3 Data Collection & Analysis

Suitable research methods for pursuing the research avenues have been established, a combination of scenario planning and roadmapping. The details about how this process will be shaped regarding data collection, data analysis, and required instruments will be presented in this paragraph. The chosen research method is in this way linked to the scientific characteristics of research, as has been thought in the MoT program (primarily based on the course MOT2312 Research methods). In doing so, primary data collection methods are mentioned.

2.3.1 Collection of Data

As previously described in paragraph 2.1.2, this research project is aimed toward the qualitative research stream. Qualitative data are data in the representation of wordings (Sekaran & Bougie, 2016). Qualitative scenario planning methods are often linked with interviews, questionnaires, focus groups, or expert panels to collect such data.

This research project is triangulated in very specific areas of multiple academic research fields. Given the nature of this research project, the relevant information is only available in certain organizations and groups. Only these participants can provide the data that can provide correct input for tackling the research avenues. The selection process of these participants is known as sampling. One thing is sure, finding suitable participants is a challenge. Because suitable participants are scarce, judgement sampling is used in this research project to find suitable participants. Judgement sampling is used when few people have the necessary information for a study. This practice focuses on subjects that are in specific positions at relevant organizations or experts in the field of blockchain in finance, especially in the payments area. Judgment sampling may make the generalizability of this study questionable, as used experts are conveniently available for this study. Nevertheless, this practice is the only viable practice for gathering the sought information from very specific people. They are the only ones who have the needed facts and expertise. (Sekaran & Bougie, 2016)

The chosen research method from Hussain et al. (2017) offers several options for participatory engagement in scenario-driven roadmapping. The options are in the range of workshops, interviews, and online platforms. There is specified that depending on the scope of the research, adaptations are possible. However, Hussain et al. (2017) does acknowledge that participatory workshops are preferred, as it supports the development of shared mental models, promote better connections and integration between the necessary steps and improve the sensemaking of the entire process. Hence, the scenario development phase of the study will be completely workshop-based. Due to the need for internal consistency between the necessary steps of the scenario-based roadmapping, the roadmapping phase will be based on logical thinking and feedback loops. Data collected from the workshop can be used in various steps for roadmapping with logical thinking. A feedback loop can be used to incorporate qualitative input on the roadmapping based on logical thinking of the scenario development data. These feedback loops will consist of interviews, preferably with participants that already were invested in the scenario development process to keep the consistency. Given the limited time for this research project, a second workshop or another form of collaborative participatory activity was not feasible for roadmapping unfortunately.

2.3.2 Analysis of Data

Data analysis of qualitative data is often focused on making valid inferences from the usually large amount of data collected during a research project. Analyzing qualitative data can become complicated because there are relatively few commonly accepted processes, rules, or guidelines on the matter. The following steps are usually taken according to the book provided during MOT2312 Research methods; data reduction, data displaying, and concluding the data. Data reduction is focused on coding, selecting, and categorizing the data in a comprehensible way. This reduced data can then be displayed in a condensed and organized manner during the data displaying process. Data displaying can be in various manners, for example, in tables, charts, diagrams, graphs, or frequently mentioned phrases, combining them is also optional. The goal of this process is to discover relationships and patterns. This might seem like a linear step-by-step process, yet this is a highly iterative process. The final process step is concluding, focused to answer research questions, and identifying themes, explanations, patterns, relationships, or contrasts. Aspects covered in this section are taken into account when analyzing the workshop and interview data.

(Sekaran & Bougie, 2016)

An important aspect of data analysis is that the derived conclusions are valid. In the context of qualitative data analysis, validity has the meaning of the extent to which research results accurately represent the collected data (internal validity) and can be generalized (external validity). Practices have been developed to achieve such validity in qualitative research. However, given the fact that this research project uses the judgement sampling practice, most practices are not suitable. Two examples of such practices are supporting generalizations by counts of events and ensuring the representativeness of cases and the inclusion of deviant cases. Counting the events will not do much as they are based on conveniently available experts and inclusion of representative and deviant cases is also not possible as there is no research found during this research project that is covering the mentioned research avenues. (Sekaran & Bougie, 2016)

2.3.3 Required Instruments

The processes of data collection and analysis happens in a digital environment as suitable participants might not be geographically in favorable locations. Furthermore, the research project started in the COVID-19 period, hence, digital meetings were preferred. This raises the question, what are the required instruments for this research project? Luckily, the Delft University of Technology supplies various tools such as Microsoft Office products and many more. Furthermore, having an university-affiliated email account provides various free access to various online platforms that can help with data collection, data analysis, and visualization of information. Lastly, given that participants might be involved in this research proposal, it is of utmost importance that everything linked to personal data is kept private due to the protection of their privacy.

During the span of the research project, various online tools have been encountered and reviewed. Possibilities in Microsoft Teams were identified, MIRO was scanned for potential use and IdeaCloud was investigated. A platform with video-telecommunications options was preferred as the workshop could then be hosted on a single platform. However, there was no available platform with this option. Due to the substantial creative freedom and templates for scenario development, MIRO was chosen. For the video telecommunications with the participants, Zoom was used, as that is still the most used form of video telecommunications worldwide.

2.4 Concluding Remarks Chapter Two

This chapter can be seen as a converging funnel for technological forecasting and strategic planning methodologies. Starting with a holistic and broad overview of the major types of technological forecasting methodologies. As the uncertainty is quite high in this research project and qualitative is desired, scenario planning is the front runner of all the described technological forecasting methodologies. The qualitative approach is even necessary from a methodological perspective, a quantitative approach would give less reliable results than a qualitative approach in this research project due to the high uncertainties. Based on the qualitative and uncertain nature, the intuitive logics approach of scenario planning was chosen. A link to strategic planning was quickly discovered when looking at the evolutionary path that scenario planning has taken in the last decades, roadmapping has been introduced and implemented with scenario planning in the last two decades.

There are even combined research methods, called scenario-based roadmapping. As described by Strauss & Radnor (2004), "*a carefully designed and implemented blend of scenarios planning and roadmapping can offer the best of both world*" (Strauss & Radnor, 2004, p. 51). Luckily, the field of scenario-based roadmapping is still upcoming and comprehensible, making it relatively easy to create an overview of the available scenario-based roadmapping methods. During the path of the described converging funnel for technological forecasting and strategic planning methodologies in this chapter, important aspects were discussed that highlighted characteristics needed for choosing a suitable method. This build-up was needed in order to answer the first sub research question (SRQ1), "What is a suitable methodology of scenario planning that can develop qualitative blockchain scenarios for the financial sector in the payments industry?"

Now that a comprehensible overview of potential research methods were presented, the most suitable could be chosen based on the highlighted characteristic that is needed for choosing a suitable method in this research project. After reviewing potential scenario-based roadmapping methods, the method of Hussain et al. (2017) was chosen, which in turn is backed by the book "Scenario Thinking" from Cairns & Wright (2017) and the roadmapping approach of Strauss & Radnor (2004). The reasons for choosing this method are the ability to use this method from an industry perspective, the use of the intuitive logics approach, and a detailed description of how the scenario planning activities are linked to roadmapping, often missing in the reviewed scenario-based roadmapping methods. The qualitative activities of this research method translate themselves into a workshop and interviews activities to collect data. Hence, answering the first sub research question (SRQ1), the method of Hussain et al. (2017) is a suitable methodology of scenario planning that can develop qualitative blockchain scenarios for the financial sector in the payments industry.

In the next chapter, an overview of blockchain in the payments industry sector is presented. Driving factors are presented for blockchain in the payments industry. These driving factors play a crucial role in the scenarios development.

3 Blockchain Status Quo

The objective of this chapter is to get a state-of-the-art view of blockchain in the payments industry sector. The goal is to find driving factors for blockchain in the payments industry. The foundation for answering sub research question 2 (SRQ2) is built in this chapter. This sub research question, "What are the contextual variables that impact the current state and future of blockchain in the payments industry?", will be answered by diving into the relevant literature. The reviewed literature proposes various driving factors that can be considered contextual variables. This chapter starts with a description of how the literature is chosen for review, followed by a synthesis of the gathered driving factors found in the literature. These driving factors are categorized into two types of driving factors and divided into a PESTLE format. This overview of driving factors will then be discussed in-depth and linked to the literature from which they are derived. To conclude, this synthesis and analysis of the literature will be used to answer sub research question 2.

3.1 Search Process and Selection Criteria

The search process for a literature review is an iterative process with activities such as scanning titles of search results, reading abstracts, skimming papers, reflecting, and finally searching for more literature based on obtained knowledge during the process (Jesson et al., 2011). During this process different configurations of keywords need to be used to gather relevant literature and reduce the chance to overlook areas of an academic field of literature. The search process has been conducted with the search websites Scopus and Web of Science (WoS), as they are meta-databases that allow searching across multiple publishers with extensive and advanced search options. The Title-Abstract-Keyword search filter has been used for all search attempts. Differentiating on document types has not occurred during any of the search attempts; book chapters, conference papers, review papers and editorials are included. Filtering options for country, publication stage, dates, names or accessibility have not been used.

As shortly described in the introduction, the academic field of blockchain is in a premature state and this status quo has been recognized during the search for literature about blockchain in the financial sector. The following keyword combination has been used to find relevant literature ((finance OR financial) AND (blockchain OR "block chain" OR "distributed ledger" OR crypto OR cryptocurrencies) AND Banking). This search attempt resulted in 346 documents in Scopus and 543 documents in WoS. Nevertheless, there are various documents that are too technical or not relevant for this research project due to the focus on other academic fields, such as blockchain for supply chain or health care. Some of these unrelated documents were excluded by limiting the search to the following subject areas; "Business, Management and Accounting", "Economics, Econometrics and Finance", "Social Sciences", and "Decision Sciences". This exclusion resulted in 192 and 264 documents in Scopus and WoS, respectively. The majority of these documents were still not relevant for this research project due to the focus on multiple technologies besides blockchain, not focused on blockchain, strong focus on a particular geographical area or not related to finance.

After scanning the titles and abstracts, 34 documents from Scopus and WoS combined, seemed promising and were skimmed. Scanning is used to gather a quick first reading to understand the overall message of an article. While quick reading, aspects regarding plausibility and added value are considered, for example, does the article contradict or add to knowledge already known? The scanning technique is performed by quickly moving your eyes across the relevant text to find particular words or phrases (Jesson et al., 2011). Skimming or skim reading is a technique to get an understanding of what is proposed in an article. Skimming entails reading quickly to get a grasp of the main points in an article, but skipping the details (Jesson et al., 2011). From the 34 promising documents, 18 documents were relevant for this research project and are used in the literature view. Images of the search results can be viewed in Figure 15. The reviewed literature proposed various interesting insights regarding the driving factors of blockchain in the payments industry, more on this is described in the next paragraph 3.2.

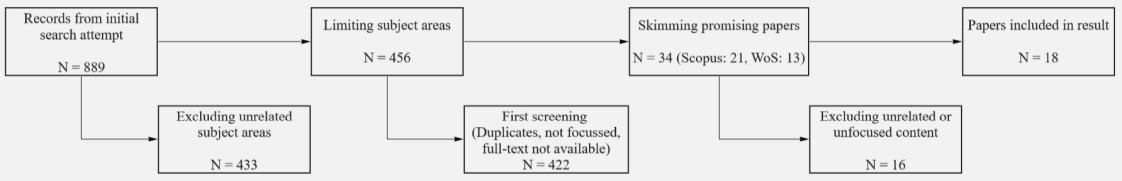

Figure 15: Search process for blockchain literature

Author(s)	Year	Title
Bateh	2019	Is the impact of blockchain and cryptocurrencies going to be as disruptive as expected by 2030? (Bateh, 2019)
Chang et al.	2020	How Blockchain can impact financial services – The overview, challenges and recommendations from expert interviewees (Chang et al., 2020)
Choo et al.	2020	Editorial: Blockchain Ecosystem—Technological and Management Opportunities and Challenges (Choo et al., 2020)
Daluwathumullagamage & Sims	2021	Review Fantastic Beasts: Blockchain Based Banking (Daluwathumullagamage & Sims, 2021)
Dozier & Montgomery	2020	Banking on Blockchain: An Evaluation of Innovation Decision Making (Dozier & Montgomery, 2020)
Fernandez-Vazquez et al.	2019	Blockchain in FinTech: A Mapping Study (Fernandez-Vazquez et al., 2019)
Gan et al.	2021	A critical review of blockchain applications to banking and finance: a qualitative thematic analysis approach (Gan et al., 2021)
Guo & Liang	2016	Blockchain application and outlook in the banking industry (Guo & Liang, 2016)
Hameed	2019	Blockchain and Cryptocurrencies Technology: a survey (Hameed, 2019)
Lipton	2017	Blockchains and distributed ledgers in retrospective and perspective (Lipton, 2017)
MacDonald et al.	2016	Blockchains and the Boundaries of Self-Organized Economies: Predictions for the Future of Banking (MacDonald et al., 2016)
Osmani et al.	2021	Blockchain for next generation services in banking and finance: cost, benefit, risk and opportunity analysis (Osmani et al., 2021)
Ozili	2019	Blockchain Finance: Questions Regulators Ask (Ozili, 2019)
Pal et al.	2020	Blockchain technology in financial services: a comprehensive review of the literature (Pal et al., 2021)
Peter & Moser	2017	Blockchain-Applications in Banking & Payment Transactions: Results of a Survey (Peter & Moser, 2017)
Valeria et al.	2022	The Impact of Blockchain Technology on International Trade and Financial Business (Valeria et al., 2022)
Zetzsche et al.	2020	Decentralized Finance (Zetzsche et al., 2020)
Zhao et al.	2016	Overview of business innovations and research opportunities in blockchain and introduction to the special issue (Zhao et al., 2016)

Table 8: Table with reviewed literature for driving factors of blockchain in the payments industry

3.2 Driving Factors

Various opportunities and developments regarding blockchain for the entire financial sector were presented in chapter 1. This paragraph focuses on the opportunities in the payments industry given the delineation of that domain. A literature review is used to retrieve the driving factors that are relevant in the payments industry. Given the large and divergent amount of aspects covered in the literature regarding blockchain developments in finance, categorization is necessary to establish an understandable but comprehensive overview. Aspects that are covered in the reviewed literature are grouped as opportunistic or challenging driving factors, factors that drive the developments forward, and factors that slow down

or even hinder developments, respectively. In the following paragraphs, the driving factors are discussed in detail and the underlying aspects are described if necessary.

Besides grouping the driving factors as opportunistic or challenging, the driving factors are also categorized using PESTLE analysis. A PESTLE analysis considered six domains: Political, Economical, Social, Technological, Legal, and Environmental. These six domains form a strategic framework that allows evaluating an (external) environment of a business by constructing a break-down of the risks and opportunities (Corporatefinanceinstitute, 2022). Furthermore, when identifying the driving factors, using a framework is recommended by Hussain et al. (2017), such as PEST analysis or its derivatives.

Before a deep dive into the literature, a synthesis of the driving factors is necessary to understand the context around the PESTLE domains and allocated driving factors. A complete overview of the opportunistic and challenging driving factors categorized in the PESTLE domains can be viewed in table 9. Further in this chapter, the literature from which this PESTLE-based overview is derived are presented in Tables 10 and 11.

Domains	Opportunistic Driving Factors	Challenging Driving Factors
Political	CBDC	Decentralization and self-governance risks Regulator perception
Economic	Cost reduction Solve double spending Economic dependency	Economic impact Risk in early adoption Business uncertainties
Social	Fear of missing out (hype) Competitive environment Corporate Social Responsibility (CSR)	Public perception Financial privacy Consumer protection Culture changes Lack of terminology
Technological	High Security Tunable privacy Bottom-up technology push (Fintech) Quality improvement	Scalability Interoperability Cyber security Data related concerns Flaws in control mechanism Technology dependency
Legal	Leveraging IP	Enforcement Liability and accountability Jurisdictional
Environmental	Low waste potential (efficient)	Storage and computational needs (Energy)

Table 9: PESTLE breakdown of the driving factors

3.2.1 Opportunistic Driving factors

The paper of Lipton (2017) discussed why blockchain is interesting for financial actors in the payments industry. When taking a closer look at banks, they are only functional as a group. Due to this nature, banks become interlinked with each other. This is making blockchain an interesting technology for handling the transactions between these interlinkages, given the decentralized and network characteristics. Some literature described blockchain as the next revolution for the financial sector, transforming the size and shape of the entire markets and potentially disrupting the market of financial services (Osmani et al., 2021). The characteristics elaborated in paragraph 1.1.1 are creating the means to disrupt the payments industry, as the key element of business in finance depends on trust (Chang et al., 2020). Due to the trustworthiness of blockchain, processes become more transparent, third parties reliance can be abolished, security of systems can be enhanced and activities can be streamlined (Osmani et al., 2021; Gan et al., 2021). This paragraph dives into these opportunistic outlooks and derive the driving factors that enable blockchain development in the payments market. This deep dive is categorized in the PESTLE framework.

Political

Cryptocurrencies are the most well-known application of blockchain in society. A similar blockchain application is currently begin investigated, however, this other digital currency is not that often discussed in the literature or society. As Lipton (2017) noted, this new form of digital currency is called Central bank-issued digital currency, also known as CBDC. A CBDC is representing an established monetary unit but in a completely digital format. These CBDCs can deal with the societal ills in the form of financial-related crimes such as money laundering, drug trafficking, illegal immigration, and potentially eradicate the costs of (physical) cash handling. These costs of handling physical cash are in the ballpark of 1 percent of a country's GDP (Lipton, 2017). As Daluwathumullagamage & Sims (2021) described, countries such as Sweden, South Korea, and Japan are experimenting with CBDCs. There is already one country with an active large-scale implemented CBDC, Nigeria with the eNaira (Zenith, 2022). In turn, financial stakeholders need to be able to process such CBDC, driving the blockchain interest as well. Nevertheless, given the nature and ownership of a CBDC, the CBDC is a political driving factor. Politicians and public agencies are in the driving seat.

Economical

One opportunity is crystal clear when diving into the literature on blockchain in finance, process optimization that results in cost reduction. Cost reduction can be considered a key driving factor in the literature. As Lipton (2017) argues the payment system, it is not broken, however, the operational expenses are high. When looking at real-time domestic transactions, the system works quite well but it is expensive and not that efficient for foreign transactions. Putting the inefficiencies in perspective, trading can take place in milliseconds, yet clearing and settlements can take up to 1 - 3 days (Lipton, 2017). Continuing with the payments systems, when financial institutions computerized the process flows, the basic centralized structures were not significantly changed. The ledgers were transformed from the paper domain to the electronic domain (Peter & Moser, 2017). blockchain can fundamentally change the process flows and centralized structure, resulting in a far less expensive system and significantly increasing the transaction processing time (Peter & Moser, 2017; Osmani et al., 2021).

The paper of Zhao et al. (2016) and (MacDonald et al., 2016) discussed the double spending problem, which can be linked to cost reduction as well. The name is quite representative of the problem, the possibility to spend the same monetary value twice. Given the immutable and decentralized characteristics of blockchain, this problem can be minimized by using a blockchain-based system. Additionally, as Gan et al. (2021) noted, reconciliation and data management costs can also decrease with blockchain usage due to its immutable characteristic.

These process innovations regarding cost reduction and solving double spending, can make a very interesting business case, however, the literature is quite shattered on the topic of how much cost reduction can be achieved when blockchain is implemented in the financial sector. The paper of Osmani et al. (2021) proposed that infrastructure costs can be reduced by 30% for banks with blockchain technology, consequentially resulting in savings of 8–12 billion USD annually. Another study on the topic by Daluwathumullagamage & Sims (2021) is proposing a cost reduction. According to this study, expectations for transaction costs reduction with the usage of blockchain can be over 50% percent, due to the elimination of costs by intermediaries and efficiency and security enhancement. With these predictions, the business case becomes vague and uncertain. In the defense of the papers, the estimations are specifically aimed at certain activities or financial actors, nevertheless, it does not create a clear overview of the potential for cost reduction for interested actors in the financial sector.

Another economic opportunistic driving factor is economic dependency, viewing the economical domain from an atypical angle compared to the previous driving factors. It is related to financial digitalization and disintermediation and considers improving a countries situation, e.g. by decreasing dependence on the US Dollar. As Bateh (2019) explained, the current world economy drives by the US Dollar. Utilizing digital currencies creates the ability to decrease the dependency on US Dollar. Countries can interconnect via their digital currencies. These digital currencies break down various barriers and limits created by the world's leading currencies, such as inflation and deregulation. However, the countries most eager to utilize such options would be countries with unstable economies, for example, Venezuela or North Korea. Moreover, as Bateh (2019) mentioned, another reason for diverting away from world-leading currencies

is if a country does not want to stand behind those economies, as is in Russia's case.

Social

The earliest paper of the reviewed literature, Guo & Liang (2016), provided various use cases in the payments industry. The paper describes that since 2015 large financial actors started planning for blockchain-based projects, such as the R3 blockchain consortium and individual actors such as Goldman Sachs, J.P. Morgan, and UBS. The R3 blockchain consortium is a collaborative group of large financial actors to improve back-end processing and reduce operational costs using blockchain (focus on payments). Some of these actors have their own established (private) blockchain laboratories. Moreover, the paper referred to studies that predicted blockchain implementation by banks. One study stated that 15% of banks will implement blockchain in 2016 and another study stated that in four years 66% of banks will have commercial blockchain at scale. These studies are also mentioned by (Osmani et al., 2021). Such predictions, consortiums, and laboratories might be driving the blockchain hype as well, financial institutions that are left out are eager to not miss the blockchain boat when it departs. However, the various divergent predictions in the literature regarding the impact of blockchain in the payments industry can create uncertainties as well. This fear of missing out can be considered a social driving factor, as it revolves around the social aspects of the financial actors across the payments industry.

Continuing with the social aspects of the financial actors across the payments industry. In the paper of Peter & Moser (2017), a survey-based paper, three respondents determined that the P2P applications of blockchain will be an interesting development in the future of payments. Two of them referred to the aspect of instant payment and that it will diffuse soon. An interesting development mentioned in this paper is that there are over 700 Startups specializing in blockchain technology (FinTech organizations). These highlighted statements from the paper Peter & Moser (2017), refer to the competitive market environment surrounding blockchain in the payments industry. One of the reasons that the payments industry is a competitive market is the FinTech movement. The financial sector is a fiercely competitive environment due to these fast-moving organizations, the need for new and out-of-the-box profit models is necessary to survive in this industry (Chang et al., 2020).

Another social driving factor is financial inclusion, which is not well discussed in the reviewed literature. Financial inclusion suggests that every human being must have access to financial products and services. Usually, households, individuals, and small businesses in remote and underdeveloped parts of the world suffer from a lack of financial products and services. Blockchain can help with providing financial products and services without geographical dependence (Daluwathumullagamage & Sims, 2021). This entails that financial institutions in the payments industry should aim to serve the unbanked as well. Creating a banking system in these underdeveloped countries with a blockchain should be a relatively cost-effective solution for creating financial inclusion. On the other hand, Daluwathumullagamage & Sims (2021) noted, that this situation creates opportunities for financial actors to gain access to a much broader capital base. Furthermore, Bateh (2019) suggests that blockchain is an integral element of the 2030 Sustainable Development Goals (SDG). The driving factor of this section can be considered Corporate Social Responsibility (CSR), it is derived from the opportunity of embracing financial inclusion.

Technological

Cryptocurrencies are the most well-known application of blockchain in society. This application is interesting for financial actors as well. As Gan et al. (2021) noted, cryptocurrencies close a gap and meet requirements that appeared unachievable; secure, tunable privacy and high-performing blockchain application. Nevertheless, these applications are currently not ready for large-scale diffusion due to low transaction throughput, more on barriers such as these in the paragraph 3.2.2. Technical driving factors that can be derived from the cryptocurrencies are the security and privacy

FinTech has introduced new and innovative services that have redefined the customer experience (Bateh, 2019), such as cryptocurrencies. The way how society transacts had changed a lot in terms of time-saving and stress (Guo & Liang, 2016). Due to these developments, financial actors need new technological growth for the acceleration of product and service innovations (Guo & Liang, 2016). These developments are driven by FinTech organizations that push blockchain developments. This bottom-up technology push by FinTech organizations can be considered a technological driving factor is given their high impact

on the financial world.

The paper of Ozili (2019) discusses the financial intermediaries of the financial system. Financial intermediation brings high costs to the financial system, leading to high costs of individual borrowing, rising costs through rising fees, delays due to necessary third parties, more paperwork, service charges per transaction, and included costs of regulatory compliance. As Valeria et al. (2022) recognized, banks begin to understand these benefits and look into blockchain to improve the quality of their financial products and services. Most aspects discussed in this section can be added to the driving factor of cost reduction, however, improving the quality of financial products and services can be considered as a technical driving factor as well.

One of the papers that can be seen as the more recent papers is the paper of Bateh (2019), stating the impact of blockchain by 2030. It is expected to disrupt traditional financial organizations. The expectation is that the leading organizations will set the standards and way of working. Further, the study mentioned that the intention of reluctance regarding blockchain is ruling the financial sector. However, the future predictions are positive, estimations are that by 2022 minimal of one innovative financial organization will create a blockchain-based product or service worth $10 billion. By 2025, the business is expected to grow by over $176 billion, and by 2030 expected to exceed $3.1 trillion. A very recent study on the topic by Valeria et al. (2022) also mentioned some predictions. The study referred to a Gartner study, indicating that blockchain is currently in an active growth phase. After this phase, investments will decline and the technology has to refocus on creating business value. The third phase, reached by 2030, will implement blockchain in economic processes.

Legal

Examples of new business opportunities for quality improvement in the literature are open markets for finance data that can be the driving factor of discovery and innovation, real-time transaction and credit monitoring, and P2P lending (Gan et al., 2021; Pal et al., 2021). Apart from new business models due to new products and services in the financial sector, the paper of Valeria et al. (2022) recognized the development of intellectual property (IP). Financial actors who can become a front runner in blockchain applications for financial purposes in a proprietary way can become a licensor of the technology if that is the goal with the IP. This could be a driving factor as well, the literature does not provide much depth on the aspects of utilizing IP in the context of blockchain in the payment industry. The paper of Chang et al. (2020) noted that the Bank of America drafted 35 patents related to Blockchain.

Environmental

As described in the technological domain, cryptocurrencies meet requirements that appeared unachievable; secure, tunable privacy, and high-performing blockchain application (Gan et al., 2021). However, these cryptocurrencies can also achieve these results with little waste. The paper by Zhao et al. (2016) discusses these aspects as well, as one of the few papers from the reviewed literature. The paper proposes improved blockchain applications by using off-chain storage and lightweight processing tasks. Another means of creating a more efficient blockchain application presented in the paper is the modification of block headers, allowing to more effectively utilize the timestamp. Thus, a driving factor that can be derived from the cryptocurrencies as well is potentially little waste.

Overview of Opportunistic Driving Factors

There are various and divergent opportunistic driving factors discussed up to this section in the chapter. To provide an overview of the mentioned opportunistic driving factors in the domains that are discussed in this literature review, a table is created, containing the opportunistic driving factors linked to the literature. This overview is presented in Table 10. This table is depicting the backbone of literature on which the left side of Table 9 is based.

Opportunistic Driving Factors	Literature
Political	
CBDC	Lipton (2017), Zetzsche et al. (2020)
Economical	
Cost reduction	Guo & Liang (2016), Zhao et al. (2016), Lipton (2017), Bateh (2019), Hameed (2019), Peter & Moser (2017), Ozili (2019), Chang et al. (2020), Choo et al. (2020), Dozier & Montgomery (2020), Zetzsche et al. (2020), Daluwathumullagamage & Sims (2021), Gan et al. (2021), Pal et al. (2021), Osmani et al. (2021), Valeria et al. (2022)
Solving double spending	Lipton (2017), Fernandez-Vazquez et al. (2019), Hameed (2019), Peter & Moser (2017), Daluwathumullagamage & Sims (2021)
Economic dependency	Bateh (2019), Pal et al. (2021)
Social	
Fear of missing out (hype)	Guo & Liang (2016), Bateh (2019), Dozier & Montgomery (2020), Valeria et al. (2022)
Competitive environment	Guo & Liang (2016), MacDonald et al. (2016), Zhao et al. (2016), Peter & Moser (2017), Chang et al. (2020), Gan et al. (2021), Dozier & Montgomery (2020), Zetzsche et al. (2020), Osmani et al. (2021)
Corporate Social Responsibility (CSR)	Gan et al. (2021), Pal et al. (2021)
Technological	
High security	Guo & Liang (2016), MacDonald et al. (2016), Zhao et al. (2016), Lipton (2017), Bateh (2019), Hameed (2019), Peter & Moser (2017), Daluwathumullagamage & Sims (2021), Gan et al. (2021), Osmani et al. (2021), Valeria et al. (2022)
Tunable Privacy	Guo & Liang (2016), Hameed (2019), Peter & Moser (2017), Daluwathumullagamage & Sims (2021), Gan et al. (2021), Osmani et al. (2021)
Buttom-up technology push	Guo & Liang (2016), Fernandez-Vazquez et al. (2019), Peter & Moser (2017), Chang et al. (2020), Daluwathumullagamage & Sims (2021), Pal et al. (2021)
Quality improvement	Bateh (2019), Chang et al. (2020), Gan et al. (2021), Zetzsche et al. (2020), Osmani et al. (2021), Valeria et al. (2022)
Legal	
Leveraging intellectual property (IP)	Daluwathumullagamage & Sims (2021), Valeria et al. (2022)
Environmental	
Low waste potential (efficient)	Zhao et al. (2016), Gan et al. (2021)

Table 10: Overview of opportunistic driving factors in the payments industry

3.2.2 Challenging Driving Factors

To successfully implement blockchain, various barriers need to be addressed. Some of these barriers can be considered great uncertainties as well, due to the possible outcomes in the future of such a barrier. Given a large amount of discovered barriers, categorization was necessary to keep a clear overview. The following themes are chosen: Political, Economical, Social, Technological, Legal, and Environmental, following the PESTLE framework.[2]

[2]This paragraph draws heavily on, and in part reproduces, material from a previously unpublished literature review paper for the course MOT2004 Master Thesis preparation (Jagesar, 2022).

Political

Politically there are quite some uncertainties regarding which actions will be taken in the future. As Osmani et al. (2021) identified, the regulatory barriers are essential to overcome before blockchain can be adopted and implemented at a large scale in the payments industry. The blockchain aspects of decentralization and self-governance are considered a risk by regulatory actors. These aspects reduce the idea of regulation, and if implemented, it could critically impact existing financial systems (Osmani et al., 2021). This lack of regulatory governance can create quite some uncertainties as the responsibilities become abstract. Financial regulators are also concerned about the increase in anonymous customers and the known misuses of this blockchain characteristic for criminal activities, currently active in the cryptocurrency environment (Peter & Moser, 2017). The challenging driving discussed in this section can be derived to decentralization and self-governance risks and regulators perception. What makes them political is the fact that there is no proper direction and discussion regarding how to deal with the mentioned uncertainties. It is up to the politicians to be the guiding force and pick a direction to cover the potential barriers and uncertainties.

Economical

There is inadequate evidence on the economic impact when blockchain will be implemented and adopted in the financial sector (Osmani et al., 2021). The human factor is something that may have a significant and uncertain societal impact. The diffusion of blockchain could transform the existing labour market, as Bateh (2019) noted, blockchain could change the traditional jobs in finance, as there will be more need for programmers. For large financial actors, blockchain implementation can become a complex personnel decision, creating conflicts in the domain of labour relations. These personnel decisions are uncertain in the sense that there is no idea what type of competencies are needed in this new blockchain-based financial system, how many people could lose their job, and the effects on the organization and industry as a whole. The economic impact has quite some uncertainties and potentially disruptive impact on the labour market, making economic impact an economically challenging driving factor.

Further, when developing new technologies, there will always be conservatism across the decision-makers. This phenomenon is based on the personal risk of a relevant manager, based on caution and considerations. This characteristic of managers are described in the literature as the perceived risk of early adoption (Osmani et al., 2021), a challenging economic driving factor. There is a risk of a "false start". This entails that a competitor will develop or have the opportunity to use a more efficient technology tomorrow. Additionally, as (Zetzsche et al., 2020) noted, the rapid growth of blockchain development continues to increase while other aspects of blockchain development lag behind, e.g. governance and legislation. This growth highlights another aspect of this barrier, the development of blockchain is faster than the time financial actors need to estimate and evaluate them. This aspect is shared by Fernandez-Vazquez et al. (2019), there are many suggested applications for blockchain now, as also described in paragraph 3.2.1, and these ideas are years ahead of actual development (Bateh, 2019). As Dozier & Montgomery (2020) elaborated, besides blockchain development, there are other technologies with better business cases that get higher prioritization in financial organizations. The aspects in this section can be considered as the challenging economic driving factor of risk in early adoption.

The challenging economic driving factor risk in early adoption is partly identified in other papers as well, however, from another perspective. First, as described in paragraph 3.2.1, business models, it is still unclear how these new services would look and perform for financial actors. As MacDonald et al. (2016) described, this is an entrepreneurial problem of the blockchain-based environment and financial actors to discover and provide such market applications. Moreover, Osmani et al. (2021) noted, that financial actors are also concerned that these new or current blockchain applications can form a threat to the current business models. From a strategic perspective, Daluwathumullagamage & Sims (2021) claimed that blockchain developments are not a business priority at this point, Dozier & Montgomery (2020) confirmed this as well. As Lipton (2017) and Peter & Moser (2017) debated, the current payment system is not broken, it is working quite well. It is inefficient and expensive, but there are no big problems. Furthermore, the literature sheds some light on the lack of skilled and educated employees, the investments necessary for blockchain implementation, and integration with existing processes and systems (interoperability) (Daluwathumullagamage & Sims, 2021). Another problem that could occur is that blockchain implementation might obliterate some advantages of the current systems (Lipton, 2017). The aspects in

this section can be considered as the challenging economic driving factor of business uncertainties. The aspects in this section go much further than just the risk in early adoption.

The earlier papers mentioned a hesitant intention regarding blockchain implementation. The study of Dozier & Montgomery (2020), a relatively recent paper, still noticed these hesitant intentions, emphasizing the uncertainties surrounding the risk in early adoption and business uncertainties. The study pointed out that the participating organizations the study are evaluating blockchain, most are looking into blockchain for almost three years currently. Nevertheless, none of the participants mentioned large-scale development or even a production implementation of blockchain within their organization. The participants still see themselves as parties in an early stage of evaluating the technology. This evaluation is conducted with side investigations and informal processes, characterized by a limited set of allocated resources for evaluation. Yet, the overall expectations of the participants regarding blockchain were positive for the next ten years. However, everyone in this study is a bit hesitant and tries to push development forward.

Furthermore, the participants of the Dozier & Montgomery (2020) study have a good understanding of blockchain technology and have processes in place to test interesting use-cases. The status quo for blockchain in finance is best described by the following explanation of participants, there is a need to understand blockchain today, if a significant opportunity arises in the future, financial actors are ready to move quickly. This is also recognizable in the prioritization of the participants regarding blockchain, more than half prioritized blockchain as low. A reason for this prioritization is other technological innovations, such as developments in faster payment, artificial intelligence (AI), or robotic process automation (RPA), are prioritized higher. The study highlighted that this development is due to the quantifiable, clear-cut, and better reachable near-term business cases linked to these other technologies. A hard conclusion came forward in this study, it seems that Blockchain is a solution looking for problems to solve, the participants employ evaluation processes to match the blockchain opportunities to current problems that are encountered within their organization. The uncertainty of risk in early adoption is making financial actors push the necessary development forward, but as explained, not too far as there is a risk to miss the blockchain boat when it departs, as presented in the opportunistic driving factors, the fear of missing out.

Social

To successfully implement and diffuse blockchain across the financial sector, societal challenges need to be addressed as well. A well-known example of a social challenge is the reports of stolen cryptocurrencies. This is often illustrated in the literature as financial fraud, scandals, commercial fraud, or scams (Pal et al., 2021). These cryptocurrency fraud cases have created an image problem (Daluwathumullagamage & Sims, 2021). The public perception is usually not that great of blockchain-based applications and developments due to these negative-oriented reports (Osmani et al., 2021). During the implementation and diffusion of large-scale blockchain usage, society might create resistance, making it an uncertain path to navigate through as financial actors are willing to disruptively implement blockchain. The presented aspects point towards a common denominator, the challenging social driving factor of public perception.

Another serious socially challenging driving factor is financial privacy, as the privacy protection of individuals and society is increasingly getting more attention (Pal et al., 2021). As Chang et al. (2020) examined, given the decentralized nature of blockchain and its consensus mechanism, transactional information is accessible to many nodes or even open to the public. With this information, transaction flows can be traced and even triangulated to specific user information through data mining. Further, Consumer protection (User-related) issues have also not been properly discussed in the blockchain literature (Gan et al., 2021). Zetzsche et al. (2020) describes this problem memorably when consumers depend on an organization's service, they cannot put such a firm under pressure, especially if that firm's (market) value is relatively high. Usually, these cases are connected with high switch costs and information asymmetry. When decentralized systems are combined in this combination, the situation becomes even more problematic for consumers who are wronged in any way. In decentralized systems, there is no firm entirely in charge. In the case of blockchain, there is a chance that systems or parts of them become self-operating at a particular moment in time. This dangerous combination makes a very complicated case for consumer protection. There is currently no solution suggested in the literature regarding the potential problems described relating to consumer protection, making it another challenging social driving factor.

One of the most discussed socially challenging driving factors in the literature is a culture change in the industry. Successful implementation of blockchain requires financial actors to interact with each other. Currently, the interaction with each other is primarily transactional. Furthermore, as Zetzsche et al. (2020) described, there is currently a lack of support points to set up a large-scale blockchain network. These support points are necessary for technical assistance and an organized and meaningful decentralized network. In the long run, this can impose problems, as a study on the topic by Zetzsche et al. (2020) noted. When decentralization is adopted, motivation to invest in, e.g., maintenance or improvements, lowers significantly. This paper referred to a quote from Milton Friedman that explains it beautifully; 'when everybody owns something, nobody owns it, and nobody has a direct interest in maintaining or improving its condition'.

Furthermore, the financial sector is considered a conservative industry. As previously mentioned in the process innovation section, paragraph 3.2.1, not much has fundamentally changed, the processes and structures in finance have just transformed from the paper domain to the electronic domain. Moreover, as Chang et al. (2020) added, this transformation has pushed finance into the IT domain. The IT domain is a competitive sector where secrecy is necessary to survive. Knowledge-hiding has been identified as a common problem in the financial sector (Chang et al., 2020). This knowledge hiding also has other reasons; career development of employees and acceptance of new ideas and ideas by senior management are not often accepted. Hence, employees rather keep new knowledge, ideas, and concepts to themselves. The common denominator of all currently mentioned organizational social barriers is culture changes, a big uncertainty in the literature. As described, the uncertainties linked to culture changes are linked to many aspects and overall quite abstract, making it complex to grasp, let alone predict or solve.

As Guo & Liang (2016) and Osmani et al. (2021) described, the involved actors have no form of standards for terminology, security, risks, governance, management, et cetera. This lack of standardization increases the complexity of the blockchain environment by continuously adding new vocabulary and not using standardized terminologies. However, Guo & Liang (2016) noted that recently an organization in Australia requested the development of global standards for blockchain technology to the International Organization for Standardization. Furthermore, The R3 blockchain consortium is also exploring and developing an industry standard for blockchain-focused interbank applications. However, currently, the lack of clarity on terminology is an uncertainty that financial actors have to deal with first. Nevertheless, it can still be considered a challenging social driving factor.

Technological

Significant uncertainties for blockchain implementation are technical challenges (Gan et al., 2021). As Lipton (2017) contrasted, VISA processes around two thousand transactions per second and Bitcoin around seven transactions per second, making scalability a clear challenging technical driving factor. Interoperability can be viewed as a challenging driving factor as well due to uncertainties in connecting blockchain to the current legacy systems and as the interaction between different types of blockchain systems (Peter & Moser, 2017), (Osmani et al., 2021). Both can be considered challenges, as actors in finance need to be able to connect their systems, and financial institutions with different blockchain configurations must be able to transact with each other. The technically challenging driving factor of scalability is currently being addressed by various bottom-up initiatives, led by the FinTech organizations. Developments in the consensus mechanisms are happening to increase the scalability, with promising results, e.g. the Proof of Work (PoW) mechanism.

Another type of technically challenging driving factor is cyber security. Most of these cyber security risks are derived from the cryptocurrency environment. First, there have been reports of cryptocurrency theft by, for example, lost or stolen private keys of wallets (Chang et al., 2020). Second, as (Zhao et al., 2016) noted, in the 51 percent attack, if the majority of nodes in a network tell a lie, the lie will be considered the truth. Third, given the increased connectivity across the actors involved, the access points to a system will also increase. New (unknown) risks may arise from the fact that the connectivity between servers will be increased (Zetzsche et al., 2020).

Furthermore, there are data-related concerns with blockchain. As Osmani et al. (2021) evaluated, there are risks in the aspects of privacy of data and secure encryption. Privacy of data is something that comes from the weaknesses in data confidentiality, given the fact that blockchain is a public system in

essence. Nevertheless, these concerns have been tackled with various blockchain architectures, such as private versus public and permissionless versus permissioned blockchain architectures, and everything in between. The chosen encryption needs to create safe systems, which is one of the core concerns with new developments in the financial world (Peter & Moser, 2017). Common mistakes in digitally-based technologies are typos or "fat fingers" and basic computer/ programming mistakes. The potential flaws in the available control mechanisms relate to error correction, given the immutability of blockchain systems, applications such as smart contracts might make mistakes and there is currently no way to correct those errors. The last technical barrier discussed in the reviewed literature is technology dependency. As Zetzsche et al. (2020) emphasized, once a weakness is detected and utilized for cybercrime, it could result in a chain reaction and compromise other networks. From this perspective, financial decentralization can potentially convert into something hazardous. The mentioned challenges in this section can be synthesized into the driving factors of data-related concerns and flaws in the control mechanism.

Legal

Regulatory and legal uncertainties to blockchain implementation are often mentioned superficially in the literature. A comprehensive overview or in-depth description of regulatory barriers is often missing. The papers which did an outstanding job in this theme are Ozili (2019) and Zetzsche et al. (2020).

As Zetzsche et al. (2020) noted, enforcement aspects are currently missing from the blockchain environment. In the current financial world, financial regulators shaped various rules and laws. This legal framework constructed the current hierarchy of liability and accountability of finance. This framework is based on a contractual perspective instead of financial or technical relationships. Moreover, as Zetzsche et al. (2020) explained, due to the geographically independent nature of blockchain, there are various jurisdictional challenges, making it hard to understand which form of applicable law is necessary if needed. This is problematic for various financial actors, as they are operating in multiple jurisdictional areas (Chang et al., 2020). These complex legal structures create uncertainties for multinational financial actors, implementing blockchain in one country might have different legal consequences than in other countries. Given these risks on the legal and regulatory theme, Ozili (2019) examined the risks and proposed questions that regulators would ask on these matters. The questions are regarding these matters are but not limited to the following topics; responsibility for rulemaking, consequences of financial losses, hand over control of finance to computers (ethics), investments/ financing the blockchain technology development and implementation, data quality of input in the system, identification of unwanted users and how to stop them, responsible parties for governance (e.g. for updates and maintenance) and if external investigators can access the blockchain systems in events of fraud (preferably without costs).

The various legal and regulatory aspects mentioned in this section can be synthesized into some major legal challenges that are presented, namely, enforcement, liability and accountability, and jurisdictional. These three major legal pillars can be seen as challenging legal driving factors.

Environmental

As the chains of a blockchain are continuously increasing, the need for storage and computational resources grows, resulting in high energy consumption (Peter & Moser, 2017). However, according to Chang et al. (2020), given the developments in blockchain, there are possibilities to decrease these efforts and need by using more energy-efficient consensus mechanisms, decreasing the uncertainties on the aspects of storage and computational needs. Nevertheless, it remains a challenging driving factor, as the current environmental impact can hinder the future development of blockchain.

Overview of Challenging Driving Factors

There are a lot of challenging driving factors to overcome before blockchain diffusion can happen on a large scale. To provide an overview of the challenging driving factors in the domains that are discussed in this literature review, a table is created, containing the discussed uncertainties linked to the literature. This overview is presented in Table 11. This table is depicting the backbone of literature on which the right side of Table 9 is based.

Challenging Driving Factors	Literature
Political	
Decentralization and self-governance risks	MacDonald et al. (2016), Peter & Moser (2017), Ozili (2019), Zetzsche et al. (2020), Osmani et al. (2021), Daluwathumullagamage & Sims (2021)
Regulators perception	Peter & Moser (2017), Ozili (2019), Fernandez-Vazquez et al. (2019), Zetzsche et al. (2020), Osmani et al. (2021), Gan et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Economical	
Economic impact	Bateh (2019), Osmani et al. (2021)
perceived risk in early adoption	Peter & Moser (2017), (Dozier & Montgomery, 2020), Chang et al. (2020), Osmani et al. (2021), Daluwathumullagamage & Sims (2021)
business uncertainties	MacDonald et al. (2016), Chang et al. (2020), (Dozier & Montgomery, 2020), Osmani et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Social	
Public perception	Osmani et al. (2021), Gan et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Financial privacy	Ozili (2019), Fernandez-Vazquez et al. (2019), Chang et al. (2020), Osmani et al. (2021), Gan et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Consumer protection	Bateh (2019), Fernandez-Vazquez et al. (2019), Ozili (2019), Zetzsche et al. (2020), Gan et al. (2021), Daluwathumullagamage & Sims (2021)
Culture changes	MacDonald et al. (2016), Peter & Moser (2017), Bateh (2019), Chang et al. (2020), Zetzsche et al. (2020), Osmani et al. (2021), Gan et al. (2021), Daluwathumullagamage & Sims (2021)
lack of clarity on the terminology	Guo & Liang (2016), Osmani et al. (2021)
Technological	
scalability	Lipton (2017), Peter & Moser (2017), Fernandez-Vazquez et al. (2019), Dozier & Montgomery (2020), Chang et al. (2020), Osmani et al. (2021), Gan et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Interoperability	Fernandez-Vazquez et al. (2019), Osmani et al. (2021), Gan et al. (2021), Daluwathumullagamage & Sims (2021)
cyber security	Fernandez-Vazquez et al. (2019), Chang et al. (2020), Osmani et al. (2021), Gan et al. (2021), Daluwathumullagamage & Sims (2021)
Data related concerns	Guo & Liang (2016), Peter & Moser (2017), Ozili (2019), Fernandez-Vazquez et al. (2019), Osmani et al. (2021)
Potential flaws in control mechanisms	Lipton (2017), Peter & Moser (2017), Osmani et al. (2021)
Technology dependency	MacDonald et al. (2016), Lipton (2017), Fernandez-Vazquez et al. (2019), Zetzsche et al. (2020)
Legal	
Enforcement	MacDonald et al. (2016), Peter & Moser (2017), Ozili (2019), Chang et al. (2020), Zetzsche et al. (2020), Osmani et al. (2021), Gan et al. (2021), Pal et al. (2021), Daluwathumullagamage & Sims (2021)
Liability and accountability	MacDonald et al. (2016), Peter & Moser (2017), Ozili (2019), Chang et al. (2020), Fernandez-Vazquez et al. (2019), Zetzsche et al. (2020), Pal et al. (2021), Daluwathumullagamage & Sims (2021), Osmani et al. (2021)
Jurisdictional	Guo & Liang (2016), MacDonald et al. (2016), Ozili (2019), Zetzsche et al. (2020), Chang et al. (2020), Daluwathumullagamage & Sims (2021)
Environmental	
Storage and computational needs	Lipton (2017), Peter & Moser (2017), Chang et al. (2020), Osmani et al. (2021), Gan et al. (2021), Daluwathumullagamage & Sims (2021)

Table 11: Overview of challenging driving factors in the payments industry

3.3 Concluding Remarks Chapter Three

An extensive but comprehensive literature review has been presented in this chapter. The literature review is extensive in the sense that 18 papers have been reviewed and synthesized in this chapter. However, due to the categorization groups of opportunistic and challenging, and thematic allocation based on the PESTLE framework, the large amount of information can be viewed in a comprehensible manner, as presented in Table 12. This table is also answering sub research question 2 (SRQ2), "What are the contextual variables that impact the current state and future of blockchain in the payments industry?"

SRQ2 is aimed at understanding what moves the direction of blockchain developments in the payments industry now and in the future. This chapter has presented various driving factors from a very select environment, blockchain developments in the payments industry. These driving factors can be considered contextual variables. The reason for this terminology is that once the context changes, for example, to sub-branches or very specific activities of the payments industry or other financial domains, the variables might vary. In this research project, the driving factors can be considered as contextual variables given their influence on blockchain developments. So, the contextual variables that impact the current state and future of blockchain in the payments industry are presented in Table 12. These contextual variables are part of the second step of the scenario-based roadmapping approach. This step entails the identification of (key) driving factors, using a framework such as PEST (Political, Economical, Social, and Technological) or its derivatives. In this case, the derivative PESTLE is used for a more comprehensive analysis.

Domains	Opportunistic Driving Factors	Challenging Driving Factors
Political	CBDC	Decentralization and self-governance risks Regulator perception
Economic	Cost reduction Solve double spending Economic dependency	Economic impact Risk in early adoption Business uncertainties
Social	Fear of missing out (hype) Competitive environment Corporate Social Responsibility (CSR)	Public perception Financial privacy Consumer protection Culture changes Lack of terminology
Technological	High Security Tunable privacy Bottom-up technology push (Fintech) Quality improvement	Scalability Interoperability Cyber security Data related concerns Flaws in control mechanism Technology dependency
Legal	Leveraging IP	Enforcement Liability and accountability Jurisdictional
Environmental	Low waste potential (efficient)	Storage and computational needs (Energy)

Table 12: Contextual variables based on driving factors that impact the current state and future of blockchain in the payments industry

Now that SRQ2 has been answered, a fundamental part of the scenario development activities is built. It is crucial to understand the contextual variables that impact the current state and future of blockchain in the payments industry, to determine how future outlooks may present themselves. The contextual variables are shaping the boundaries in which the future outlooks can be developed as they form the foundation of the scenario development process. The contextual variables are used to derive the most impactful and uncertain factors, those are the core of the future outlooks. In the next chapter, the scenario development activities are described.

4 Scenarios

The objective of this chapter is to develop scenarios utilizing a workshop to answer sub research question 3 (SRQ3), "What are possible scenarios of blockchain for the payments industry?". The driving factors from the previous chapter are utilized and presented to an expert audience for validation. Further, the experts proposed additional driving factors and ranked the driving factors in terms of impact and uncertainty towards the future. Thereafter, the experts participated in the collaborative part of the workshop to create a scenario frame and in turn develop scenarios. After data analysis, scenario narratives are written. These scenario narratives are an answer to SRQ3. The chapter starts with a short description of how the workshop is designed. Followed by an introduction of the workshop and the steps that are needed to result in the scenario narratives, which in turn answer SRQ3.

4.1 Workshop Design - Scenario Planning

The scenario planning workshop focuses on identifying possible future outlooks of blockchain in the payments industry for 2030. Future outlooks that are with plausible occurrence, yet not assured. The principle of scenarios lies in exploiting a group and their combined intuitive knowledge. This workshop helps in reaching one of the research objectives: building future outlooks of blockchain in the payments industry. This workshop is based on the chosen scenario-based roadmapping method (Hussain et al., 2017) and the book "Scenario Thinking" by Cairns & Wright (2017).

The workshop follows the steps linked to the chosen research methods; setting the scene, impactful driving factors, uncertainties, scenario framing, and scenario development. The scenario narratives are written with the data gathered from the workshop. The steps needed to develop the scenarios are explained to the participants, thereafter, the activities were performed linked to the necessary steps. The book of Cairns & Wright (2017) has been used for the design of the steps that participants are affiliated with. Aspects such as: how to fill in an impact/ uncertainty matrix, create scenario frames with participants, practical pitfalls during hosting a workshop, and time allocation per step were derived from the book "Scenario Thinking" by Cairns & Wright (2017). In-depth information and details about the process flow and visual design of the workshop can be seen in Appendix B.

The reviewed literature does not provide any guidance on how to select experts, for example determining the necessary qualifications or demands of participants involved in scenario planning workshops. The following guidelines were used to search for suitable participants.

- Expertise and experience of blockchain in the financial and banking sector preferably focused on the payments industry.
- This translates into a minimum of 2 years of experience or 2 blockchain projects in the field of payments.
- **OR**
- Significantly relevant knowledge in blockchain for financial services or applications in the areas of Law, Ethics, Economic impact/ policy, Environmental impact, Social sciences, Hardware and software development, or technology development and diffusion.
- Knowledge and expertise in governmental and societal implications of technology development and diffusion in finance or with blockchain-related projects are also acceptable.

The reason for this wide spread of acceptance requirements is because it is extremely hard to find people with this knowledge, let alone those willing to participate and share their knowledge. Furthermore, keeping the acceptance requirements wide is desired, as it is important to get a spread of participants with a broad combined knowledge set. This results in much richer scenarios and decreases to overlook of certain aspects, but also make sure that one domain is not over-presented and shapes the scenarios in a dominant domain.

4.2 Workshop Introduction

The workshop was hosted on April 26, 16:00 - 18:00 CEST. As any event must have, some introductory formalities were set up to welcome the participant. Appendix B.1 presents the introductory frames for the participants that are joining the Miro board. If someone joins the invite-hyperlink to the Miro board, those frames are the first view when a person is loaded into the board. The workshop consists of two parts, the first part is more individual-based and the second part is more discussion-based due to collaborative activities. Lastly, Nadia Metoui[3] was introduced, as she was the co-facilitator and helped with managing the data input, questions from participants or miscellaneous activities. The participants had the opportunity to become familiar with the Miro board in a warm-up session.

4.3 Driving Factors Validation

Before diving into the results of the scenario workshop that resulted in the developed future outlooks, it is useful to grasp the overview of the steps that are involved in this chapter that contributed to the future outlooks, also described as scenario narratives. These steps are presented in Figure 16, with in this paragraph the first step, validating the driving factors.

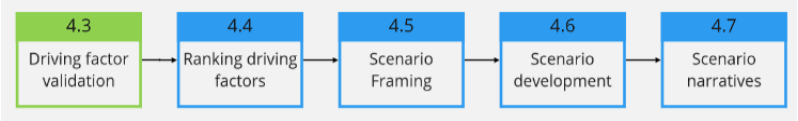

Figure 16: Scenario steps - validation

The first step of the workshop is regarding the driving factors that have been found in the literature review, drafted in chapter 3. The instructions that the facilitator mentioned about this first step are presented in Appendix B.2. The main assignment of this first step was to think of new driving factors. The results of this activity, the new driving factors, are presented in Figure 17.

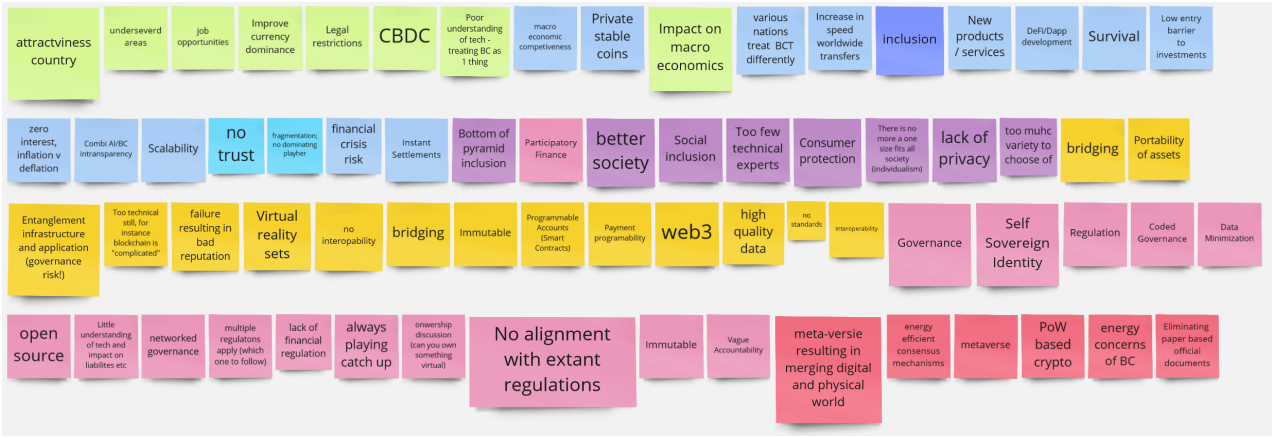

Figure 17: New Driving Factors

Figure 18: Legend of New Driving Factors

[3] Assistant Professor in Artificial Intelligence and Ethics at TU Delft, part of the Information and Communication Technology Group at the TPM Faculty.

The factors presented in Figure 17 are new in the sense that some are not covered in the literature regarding aspects that can influence the future of blockchain in the payments industry from the perspective of financial institutions. Figure 18 presents a legend for the definitions of the colours that have been used to categorize the new factors. These factors are derived from the contextual factors drafted in the previous chapter.

New list of driving factors

- **New political:** Attractiveness country, Underserved areas, Job opportunities, Improve currency dominance, Legal restrictions, CBDC, and Poor understanding of tech - treating BC as 1 thing.

- **New Economic:** Macro economic competitiveness, Private stable coins, Impact on macro economics, Various nations treat BC differently, Increase in speed worldwide transfers, Inclusion, New products / services, DeFi/Dapp development, Survival, Low entry barrier to investments, Zero interest - inflation vs deflation, Combination AI/BC in transparency, Scalability, No trust, Fragmentation - no dominating player, Financial crisis risk, and Instant Settlements.

- **New Social:** Bottom of pyramid inclusion, Participatory Finance, Better society, Social inclusion, Too few technical experts, Consumer protection, There is no more a one size fits all society (individualism), lack of privacy, and Too much variety to choose of.

- **New Technical:** Bridging, Portability of assets, Entanglement infrastructure and application (governance risk!), Too technical still - for instance blockchain is "complicated", Failure resulting in bad reputation, Virtual reality sets, No interopability, Immutable, Programmable Accounts (Smart Contracts), Payment programmability, Web3, High quality data, No standards, and Interoperability.

- **New Legal:** Governance, Self Sovereign Identity, Regulation, Coded Governance, Data Minimization, Open source, Little understanding of tech and impact on liabilities etc, Networked governance, Multiple regulations apply (which one to follow?), Lack of financial regulation, Always playing catch up, Ownership discussion (can you own something virtual), No alignment with extant regulations, Immutable, and Vague Accountability.

- **New Environmental:** Meta-verse resulting in merging digital and physical world, Energy efficient consensus mechanisms, Metaverse, PoW based crypto, energy concerns of BC, and Eliminating-paper based official documents.

This new list of driving factors has a much broader coverage of all the opportunities and challenges that are currently dictating the future of blockchain in the payments industry. The new driving factors derived from the expert group have much finer granularity as well. During the literature review, some elements were recognized as well, such as "labour impact" or "PoW crypto", but were grouped under a collection of an opportunistic or challenging driving factors. Other elements such as "Meta-verse" or "Portability of assets" were not even touched upon in the literature. One of the participants shared a very interesting perspective on current developments in the blockchain ecosystems that will impact the future of the payments industry. This perspective sheds light on the many new driving factors, as quite of them are in the domain of economical, technological, and legal, as described below.

"If you are thinking about 2030 for the future and what we are seeing right now, is that in a blockchain ecosystem the DeFi/ decentralized applications are evolving very fast. New money is flowing in various projects in the form of stable coins or other cryptocurrencies. This type of currencies will then also be used in these kind of projects. So, in the future, if those projects will evolve, there will be a need for a currency that will be used on these blockchain platforms, this could be stable coins. Maybe a CBDC, it depends on how they will develop it, but for sure, we will have a new form of currency that will be fully digital. Banks will have to take care of this from a regulation perspective but also from an application perspective, basically from a total business perspective."

4.4 Ranking Driving Factors

This paragraph focuses on follow up step of ranking driving factors, as presented in Figure 19.

Figure 19: Scenario steps - ranking

With the newly updated list of driving factors, ranking them is step two. The reason for the necessity of ranking is since not all driving factors are equally important. A voting tool is used within Miro to rank the factors with the highest impact and uncertainty. Elaboration regarding how the voting tool works in Miro is shown in Appendix B.3. It is important to understand this exercise is not regarding the uncertainty about whether there will be an impact, but about what that impact may be (Cairns & Wright, 2017). Ranking the driving factors happened in two phases. First, the driving factors with the highest impact needed to be found. Second, the uncertainty of the most impactful driving factors needed to be determined. Given the large amount of new driving factors proposed by the expert group, various rounds of voting were necessary to find the most impactful and uncertain driving factors. The voting round are listed below;

- **Impact voting**

  Voting 1 - Top 15 = 4 min voting (15 votes per person, one vote per object)

  Voting 2 - Top 10 = 2 min voting (10 votes per person, one vote per object)

  Voting 3 - Top 5 = 1 min voting (5 votes per person, one vote per object)

  Voting 4 - Top 3 = 1 min voting (2 votes per person, one vote per object)

- **Uncertainty Voting**

  Voting 5 - Top 5 = 2 min voting (5 votes per person, one vote per object)

  Voting 6 - Top 3 = 1 min voting (2 votes per person, one vote per object)

The driving factors that came forward from the various round of voting are presented in Table 13, and screenshots of the voting results can be viewed in Appendix B.3.1. The results listed in the Table 13 are described starting from the highest to the lowest amount of votes.

Voting Rounds	Results
Voting 1	6 votes - Legal restrictions 5 votes - Programmable accounts (smart contracts) 4 votes - Governance, Consumer protection, Impact on macro economics, Poor understanding of tech - treating BC as 1 thing, Lack of financial regulation, Vague accountability, Multiple regulations apply (which on to follow?) 3 votes - CBDC, Macro economic competitiveness, Various nations treat BC differently, Low entry of barrier to investment, Financial crisis risk, Portability of assets, Entanglement infrastructure and application (governance risk), Too technical still, for instance BC is "complicated", Failure resulting in bad reputation, No interoperability, Self sovereign identity, regulation, no alignment with extant regulations
Voting 2	7 votes - Governance 5 votes - Regulation 4 votes - Legal restrictions, Programmable accounts (smart contracts), Poor understanding of tech - treating BC as 1 thing, Multiple regulations apply (which on to follow?), Vague accountability, no interoperability 3 votes - Portability of assets, Consumer protection 2 votes - Macro economic competitiveness, Impact on macro economics, Financial crises risk, Too technical still, for instance BC is "complicated", Self sovereign identity, Lack of financial regulation, no alignment with extant regulations 1 vote - Various nations treat BC differently, Low entry of barrier to investment, Entanglement infrastructure and application (governance risk), Failure resulting in bad reputation
Voting 3	6 votes - Governance 5 votes - Regulation 4 votes - Vague accountability, No interoperability 3 votes - Legal restrictions, Programmable accounts (smart contracts), portability of assets 2 votes - Multiple regulations apply (which on to follow?) 1 vote - Poor understanding of tech - treating BC as 1 thing 0 votes - Consumer protection
Voting 4	6 votes - Governance 4 votes - Regulation 3 votes - No interoperability 0 votes - Vague accountability
Voting 5	6 votes - Regulation 4 votes - Governance, Legal restrictions, Vague accountability, Portability of assets 2 votes - Programmable accounts (smart contracts), Poor understanding of tech - treating BC as 1 thing, Consumer protection, No interoperability 1 vote - Multiple regulations apply (which on to follow?)
Voting 6	6 votes - Regulation 3 votes - Portability of assets 1 vote - Vague accountability, Governance, Legal restrictions

Table 13: Ranking of Driving Factors Based on Voting Rounds

The first voting already showed some interesting results, the social and environmental domains are not that impactful according to the expert group. From the social domain, only the driving factor consumer protection made it to the top 15 list and from the environmental domain, not a single driving factor is considered impactful for the future of blockchain within the payments industry in 2030 from the perspective of financial institutions. Yet, the legal domain contains the most voted impactful and uncertain driving factors. One of the participants explained why this might be the case, as described below.

"Well, it is quite simple, legal restrictions can prohibit the use of a lot of assets. The problem is that there is especially amongst politicians very poor understanding of what the [blockchain] technology is. They have a poor understanding of the technology and treating blockchain as one thing without being very specific in what they mean. So, you see a lot of regulation being designed and trying to tackle very specific problems, but actually they are tackling the whole industry or part of that [blockchain] industry in this case. So, regulations can make or break this case, especially for the financial sector because it is a highly regulated sector in itself."

The next step was mapping the most impactful and uncertain driving factors in an impact uncertainty matrix. The necessary driving factors needed to be pasted into a matrix, these factors are chosen during the previous step, and the most important ones are described in Table 14.

Voting Rounds	**Results**
Voting 4	Most impactful driving factorsy 6 votes - Governance 4 votes - Regulation
Voting 6	Most uncertain driving factors 6 votes - Regulation 3 votes - Portability of assets

Table 14: Most impactful and uncertain driving factors

4.5 Scenario Framing

Now that the driving factors are ranked, mapping them in an Impact/ Uncertainty Matrix is the next step, as presented in Figure 20.

Figure 20: Scenario steps - framing

This step places the impactful and uncertain driving factors in perspective. Mapping these driving factors happened in an Impact/ Uncertainty Matrix, in turn forming the foundation of a scenario frame. This activity belongs to the second part of the workshop, part two is more collaborative. So, the participants could discuss and respond to questions or comment on the positioning of the driving factors in the Impact/ Uncertainty Matrix. In the case that some impactful driving factors have the same ranking based on the voting, the literature suggests that "where two factors sit equally positioned, in terms of distance from the top right corner of the matrix (highest impact and uncertainty), the one with the highest uncertainty attached should be selected, to give the greatest spread of possibilities of outturns from which to construct scenarios." (Cairns & Wright, 2017, p. 44).

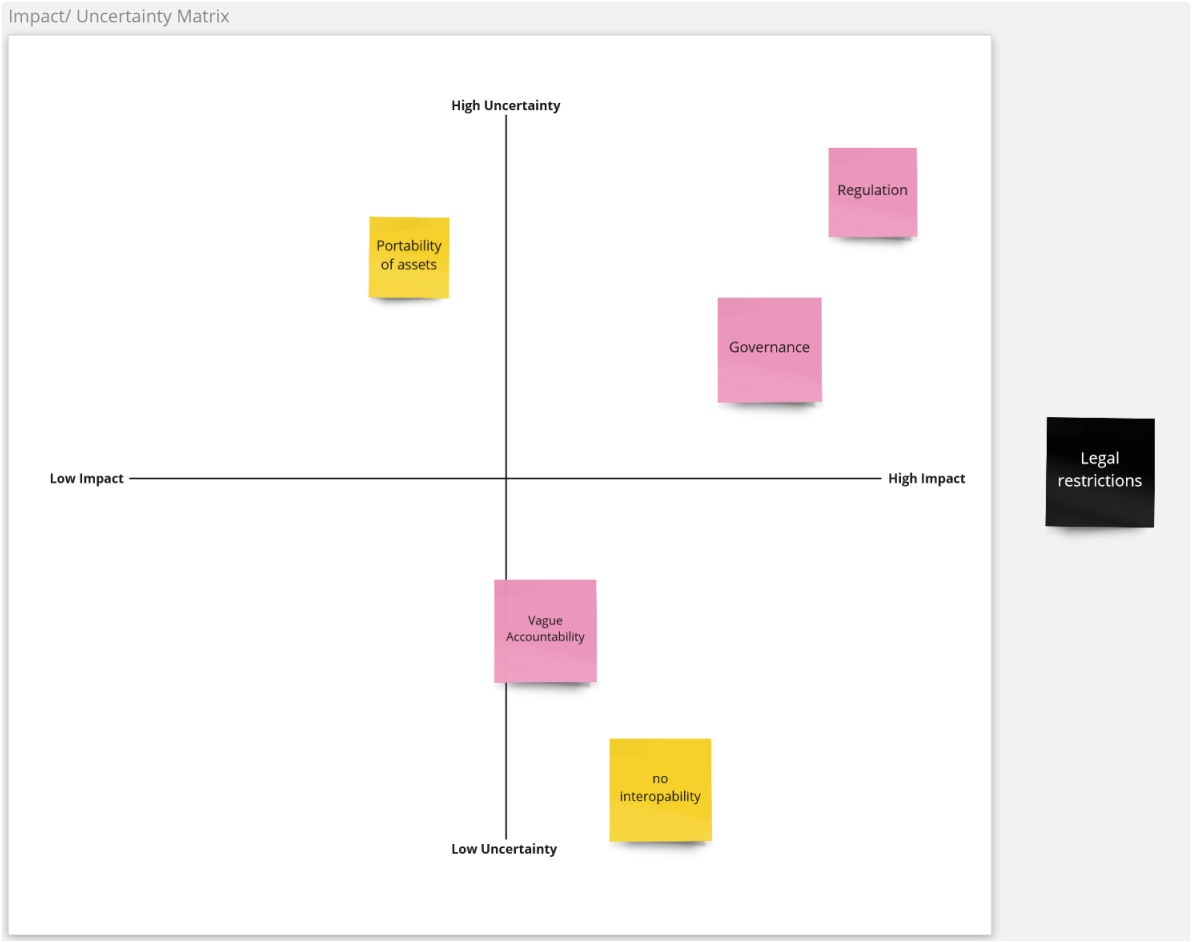

Figure 21: Impact Uncertainty Matrix

As can be seen in Figure 21, "Legal restrictions" is left out of the matrix. Yet, based on the votings from the previous activity "Legal restrictions" should be quite impactful and also with some degree of uncertainty. The reason for leaving this driving factor out of the matrix is because it resembles the driving factor "Regulation". This choice is based on a group discussion about the question: What is exactly the difference between legal restrictions vs. regulation? The discussion can be summarized as followed; the legal restriction is part of regulation, and the legal instruments that we have when we regulate are not only legal restrictions but also permissions or liability. So, it makes sense to leave legal restrictions out of the matrix because they can be considered part of regulation.

Now that the impactful and uncertain driving factors are put in perspective, presented in Figure 21, the scenario framing could start. The factors with the highest impact and relative highest uncertainty were selected for the endeavour of scenario framing. Scenario framing entails that the chosen driving factors with the highest impact and relative highest uncertainty are used to create scenario frames by contrasting them against each other. Means that the extremes of both factors are taken into consideration and combined to create the core foundations for scenario development. By combining the spectrum of each impactful and uncertain driving factor, the scenarios are shaped, as presented in Figure 22.

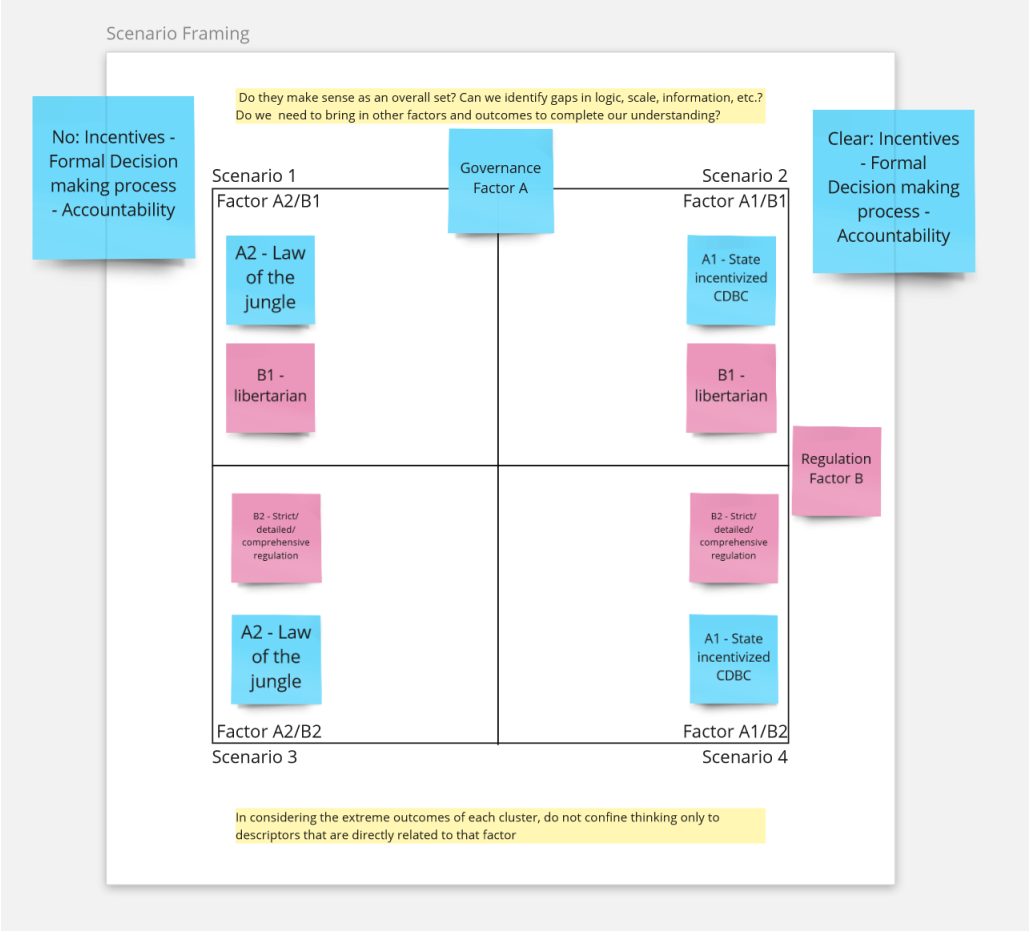

Figure 22: Scenario Frame

Creating this scenario frame was quite challenging, and finding the extremes of governance took the most time. As one of the participants described, *"You cannot have no governance, that just does not exist. So, if you choose the Law of the Jungle, then you still have governance"*. After further discussion, this perspective remained quite interesting, and as a group, it was decided that the "Law of the Jungle" is one of the extremes for governance. One of the participants immediately countered as follows, *"The opposite of law of the junle is a highly restricted, highly regulated, highly centralized environment*, creating the other extreme of governance "State incentivized CBDC". The names of these extremes are aimed to represent the discussion for which they stand for and an easy-to-remember name, e.g. a catchy title.

The discussion for regulation was a lot quicker. One extreme was found immediately, "Libertarian". Finding the opposite of Libertarian took a bit longer. The first idea was strict regulation, however, one participant noted, *"I think the opposite of no regulation is not necessarily strict regulation, but detailed regulation. Comprehensive regulation so that there is a solution for every possible case that may arise. So, I would call it, detailed regulation, comprehensive regulation"*. Nevertheless, strict regulation still had merit. Hence, the perspectives were merged and became altogether the opposite extreme of Libertarian. Sadly, no catchy or easy-to-remember name could be found for this extreme of regulation.

4.6 Scenario Development

Figure 23: Scenario steps - development

The established scenario frame from the previous step can be used to develop scenarios. This is the next step in the scenario development process, as depicted in Figure 23. Given the short amount of time left and the smaller group than initially participated, a pragmatic approach was initiated to get the most out of the remaining time and participants. A work environment was created where two scenarios could be developed. The entire group went to work on scenario one (Factor A2/B1) and after a short period, they all worked on scenario 4 (Factor A1/B2). The choice for developing scenarios one and four was a judgement call based on a fundamental piece of text in the literature; "The scenarios A1B2 and A2B1 frequently yield the most productive thinking about the future" (Cairns & Wright, 2017, p. 45). With logical thinking it can also be determined that scenario 2 and scenario 3 are not making a lot of sense, they are quite counter-intuitive. The scenario resulted in a brainstorming session with a very broad range of descriptors that characterize scenario one (Factor A2/B1) and scenario 4 (Factor A1/B2).

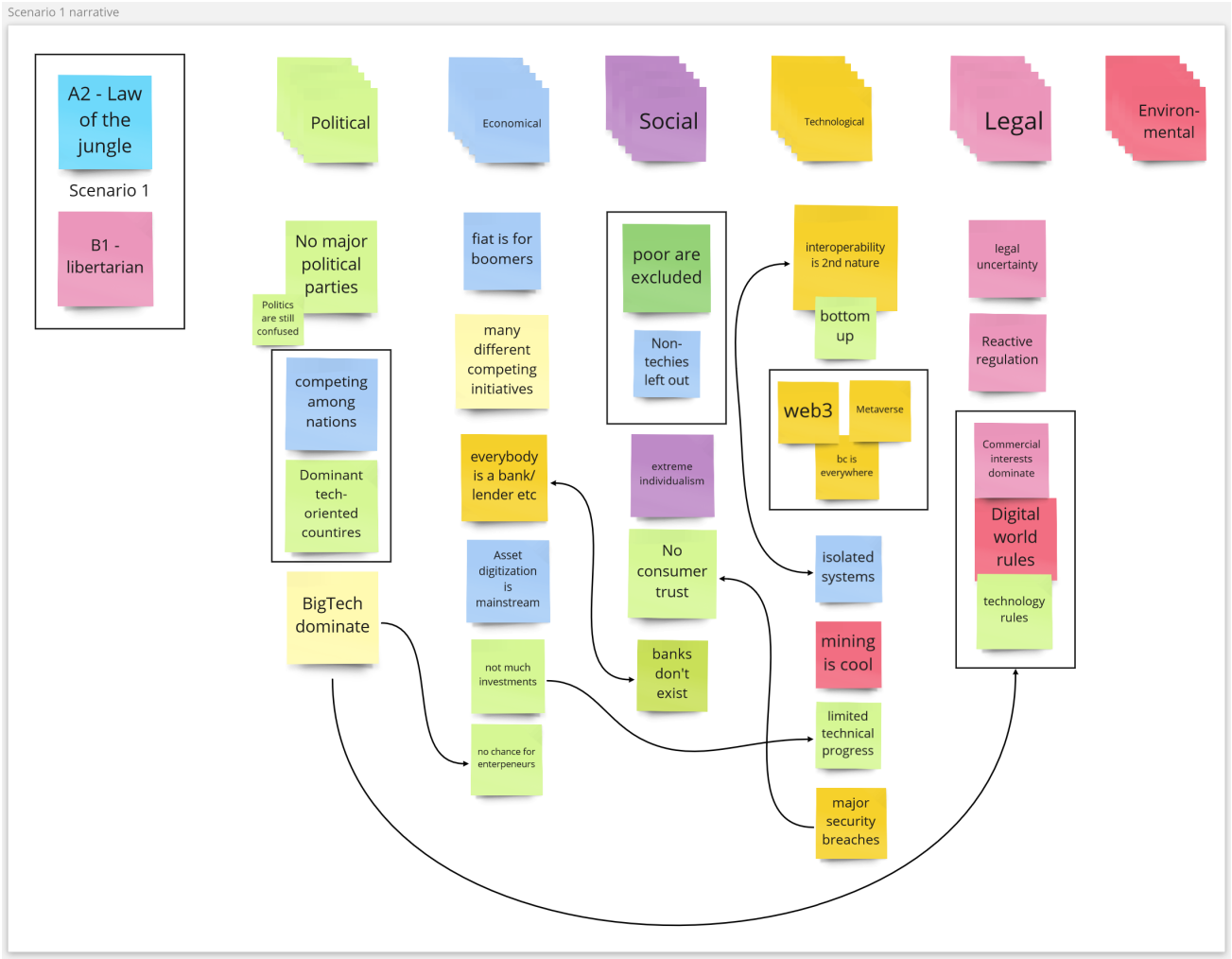

Figure 24: Scenario 1 - Structured Results

In Figure 24 the descriptors of scenario 1 are presented. This scenario sketch represents a combination of "law of the Jungle" and "Libertarian". This scenario is driven by BigTech dominance and the digital/ technology entities that are ruling. Given that Blockchain is everywhere, the world revolves around web3 and other blockchain applications, resulting in an ecosystem where there is no place for a traditional bank because everyone can become a bank (P2P lending). However, due to the dominance of BigTech and its rules, not many new investments will be done in certain areas, leading to limited technical progress. Due to the large dependence on these BigTech systems, without participating in these systems, you will be left out. To the great influence of BigTech in this scenario and broadening applications of blockchain, this scenario is called the **"Techno-verse"**.

In Figure 25 the descriptors of scenario 4 are presented. This scenario sketch represents a combination of "State incentivized CBDC" and "Strict/ detailed/ comprehensive regulation". This scenario is driven

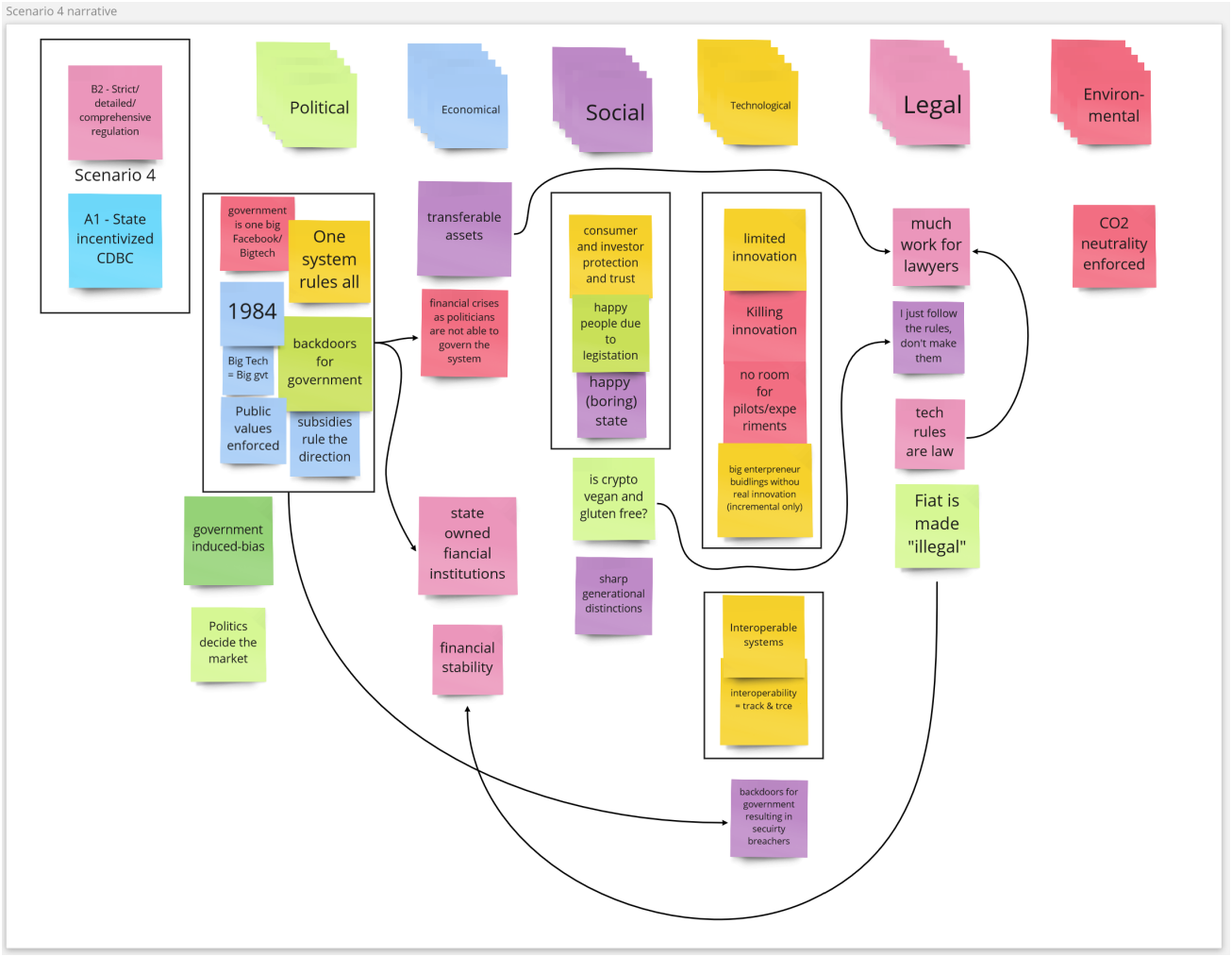

Figure 25: Scenario 4 - Structured Results

by one blockchain-based system that is diffused everywhere and controlled by governments. The ones driving this national blockchain system are politicians, chosen by the public, resulting in a good focus on public values in the development of the blockchain system. Hence, you are controlled by the government, creating an ideal public environment with values such as trust, safety, and environmental consciousness. Nevertheless, this ideal environment is vulnerable to security breaches due to the interoperability of this one large-scale blockchain-based system. Society will not care about the potential risk, as they are happy and feel trust and safety in the government. As long as their payment method is vegan and gluten free, meaning that society just wants the benefits and does not want to see the downsides. This scenario is shaped by the great influence of the government, with users that have a mindset such as, "I just follow the rules, I don't make them". Hence, the name **"Big Brother"** seems quite applicable to this scenario.

These overviews provide a general understanding of the key points in the developed scenarios. In the next paragraph, the developed scenarios are analyzed in more depth. This results in scenario narratives, also known as scenario stories which cover the mentioned descriptors in a coherent storyline.

4.7 Scenario Narratives

Figure 26: Scenario steps - narratives

The last step of the scenario development process entails creating scenario narratives, as presented in Figure 26. When creating these narratives, it is advised to resonate with the users of the scenarios when creating the narratives (Hussain et al., 2017). The users of the scenario are interpreted to be the leading organizations in the respective scenario. The narratives are based on the descriptors provided by the participants of the workshop, which were presented in the previous paragraph, in Figures 24 and 25. These descriptors are forming the building blocks to create a coherent and overarching snapshot of the future, shaped by the essence of the merged descriptors. Every descriptor is reviewed separately but categorized in each of the PESTLE domains. These descriptors are summarized in key focal points and finally, the PESTLE-based focal points are merged into one overarching scenario narrative, complemented with visuals.

4.7.1 Scenario 1 - Techno-verse Analysis

Descriptors	**Analysis**
Political	
No major political party	Usually a (large) political party or coalition is guiding a country in a certain direction. Things are different in **Techno-verse**, there is an ecosystem of large BigTech firms which have substantial control, also political power by their reach to the public, an example: the US elections of 2020 (Suciu, 2020).
Politics are still confused	As came forward in the workshop, "They have a poor understanding of the technology and treating blockchain as one thing without being very specific in what they mean". Resulting in BigTech thriving and politicians lost in how to get a grip on these developments.
Competition among nations + dominant tech-oriented countries	Geopolitical things have changed in **Techno-verse**, countries that are tech-oriented will thrive. For example, countries with stable energy grids, good digital infrastructure, and favorable tax laws will attract BigTech headquarters.
BigTech dominates	Due to the power of the public, BigTech dominates the payments industry.
Economical	
Fiat is for boomers	The new currency in which transactions will happen is backed by a physical commodity or even perhaps a digital commodity (Chen, 2022). A big shift from the currencies such as US Dollar or Euro.
Many different competing initiatives	As are happening now in the cryptocurrency markets, various organizations are trying to create a better cryptocurrency for certain types of use.
Everybody is a bank/ lender	Financial products and services will no longer only be offered by banks, with P2P networks, everyone can perform activities that a bank can in terms of payments.
Asset digitalization is mainstream	Besides currencies in a digital format, other (physical) assets can be digitalized. For example, ownership of physical art, cars, or even houses (Consensys, 2022).
Not many investments + no chance for entrepreneurs	There is not much room for new entrants in the payments market, As the network externalities are so extensive for BigTech organizations. The investments that are done, will probably be accompanied by an incubator of a BigTech firm, to either strengthen their strategic capabilities or be shelved.
Legal	
Legal uncertainty	There are quite some legal uncertainties in this scenario, especially in terms of accountability and enforcement. The responsibilities are unclear. Perhaps, these will be lawless digital environments, the only rules that need to be satisfied are the terms and conditions of the BigTech platform of your choice.
Reactive regulation	Regulation will be created when substantial harm is done (Cyberfort, 2022).
Commercial interest dominate + digital world rules	As BigTech has a great influence on politics, the laws will be bent towards their vision with lobbying activities and power to shift the election outcomes.

Table 15: Analysis of Techno-verse descriptors part 1

Descriptors	Analysis
Social	
Poor and non-technicals are left out	The BigTech organizations' network externalities are so extensive, not participating means being excluded from an average/ ordinary person ecosystem, as there is no ability to perform transactions.
Extreme individualism	A way of life that represents itself as freedom, however, results in selfishness (Briant, 2021).
No consumer trust	As Zetzsche et al. (2020) described, when consumers depend on an organization's service, they cannot put such a firm under pressure, especially if that firm's (market) value is relatively high. Usually, these cases are connected with high switch costs and information asymmetry.
banks don't exist	Traditional Banks no longer exist, they will perform other activities but are no longer in the centre of the payments sector. For example, they are now more focused on asset digitalization, assisting in portfolio management, and perhaps the only way for poor and non-technicals to participate in this new world, however this shift in activities will come at a price as the banks will need to change their business model.
Technological	
Interoperability is 2nd nature	Large BigTech organizations rule the payments industry because interoperability is second nature, meaning that a common set of aspects in the digital payment applications can work together to create a cohesive combined powerful network of payment options (Holmes, 2022).
Web3 + metaverse + BC is everywhere	as (Guo & Liang, 2016) noted, blockchain is the next disruptive internet innovation. This direction is aimed at creating a blockchain-based internet (Web3), making the internet more fair and sovereign (Forbes, 2020). Another example of blockchain development is the non-fungible tokens (NFTs). These developments are creating an independent virtual economy, also known as Metaverse, enabled by digital currencies and NFTs, all driven on a blockchain-based system (Gupta, 2022).
Isolated systems	There is a network of payment options, nevertheless, these individual digital payment applications are owned by individual BigTech organizations and can be seen as an isolated system in essence.
Mining is cool	Blockchain networks need some form of computational power to function. The BigTech organizations are allowing people to utilize their computational power for these organizations. Developments such as Multi-party computing make and new consensus mechanisms make this happen.
Limited technical progress	As there is little real competition among the ruling BigTech organizations, there is no need to constantly push for more innovation. The stream of creative innovations from bottom-up initiatives has been dried up by little investments.
Major security breaches	A big risk is a security breach. It is not a matter of "if" but "when". Once someone is deeply invested in the system, it can have serious complications. Also for the (financial) privacy of the users. Furthermore, these large and highly connected systems can open pandora's box, there might be risks involved that are now unimaginable and will only present themselves in this environment.

Table 16: Analysis of Techno-verse descriptors part 2

4.7.2 Scenario 1 - Techno-verse Narrative

With the analysed descriptors, presented in Tables 15 and 16, the essence from PESTLE domains can be described in some focal points. The PESTLE-based focal points are merged into one coherent and overarching scenario narrative, complemented with visuals, presented in Figure 27. The images used in the scenario narrative are respectively from Clarke (2022)[4] and Weston (2021)[5].

[4] "Crypto millionaires are pouring money into Central America to build their own cities" by Clarke (2022) (https://www.technologyreview.com/2022/04/20/1049384/crypto-cities-central-america/)

[5] from "NFTs and Their Role in the "Metaverse" by Weston (2021) (https://101-blockchains.com/nfts-and-metaverse/)

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Techno-verse

Shivaye Jagesar

This scenario sketch represents a combination of "law of the Jungle" and "Libertarian". It is driven by BigTech dominance and the digital/ technology entities that are ruling. Given that Blockchain is everywhere, the world revolves around web3 and other blockchain applications, resulting in an ecosystem where there is no place for a traditional bank because everyone can become a bank.

Political

BigTech organizations have substantial power, political power by their reach to the public. While BigTech is thriving, politicians are lost in how to get a grip on the growing ecosystems of BigTech. Countries that are tech-oriented will thrive, as they attract BigTech to operate from there.

Economical

Fiat currencies such as US Dollar and Euro circulating movements are decreasing. People are getting used and become dependent on the BigTech issued digital currencies. 2030 has still quite some options in digital currencies. Once obtained, these currencies can be interchanged for other largely accepted currencies or used in transaction. Not only currencies are digital, but other assets have also been digitalized as well. Users can perform P2P transactions, without third parties.

Legal

Accountability and enforcement are vague concepts. Proving who is responsible for something will be hard. Politicians that try to put a hold to these developments are coming up with reactive regulation, constantly fishing behind the net.

Social

People that cannot afford digital devices or stable internet or people with low levels of digital literacy will be eventually left out. People are feeling absolute freedom in this new ecosystem, however, the actions are pointing towards selfishness. Nevertheless, the world is financially stable and individually people have the ability to thrive.

Technical

The BigTech organizations have isolated systems. Yet, there is the applications of the individual organizations can work with each other. These large-scale blockchain-based systems need large amounts of computational power to run. The users of the systems can offer their computational power for compensation if they desire. The huge amounts of stored data in such large-scale and connected systems will eventually encounter great security threats. Threats that are not even imaginable now.

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Figure 27: Techno-verse Narrative

4.7.3 Scenario 4 - Big Brother Analysis

Descriptors	Analysis
Political	
One system rules all + Government is one big BigTech + 1984	The government will have a blockchain-based system for its entire population in it, probably linked to a social security type of number to identify each user. This system will form the backbone of the payments system in the financial markets. There will be total control, everything will go through the governments' systems, with the promise of safe and reliable systems. The payment options will consist of a set of CBDCs. Yet, there is always the possibility that big brother is watching and that your data can be used against you at a certain point in time.
public values are enforced	The government has public values as a priority. Public values are the values that are chosen by the politicians, which are powered and placed with the voice of the citizens in most democratic countries. Hence, there is no telling what the values will be that are pursued and enforced. The best guesses are in the realm of privacy, safety, reliability, and sustainability. Legal frameworks will also be developed to push innovation and the systems towards the goal of reaching public values.
Politics decide the market + subsidies rule the world	To pursue and enforce the public values, a budget is needed to develop and maintain a system that is aimed at achieving such values. The payments system will be in the essence of the ones that are using it, the citizens.
Economical	
Transferable assets	(Physical) Assets can be digitalized and transferred. For example, ownership of physical art, cars, or even houses (Consensys, 2022).
Financial crises as politicians are not able to govern the system	Politicians are trying to do the best they can given the circumstances and aim at reaching public values. Yet, politicians are facing something they have never encountered before, complete control of the payments systems in a country. They have no experience in governing such an ecosystem and are putting out fires while a new one starts for the ones that have been extinguished.
State owned financial institutions	As explained in paragraph 3.2.1, the traditional banks are the gatekeepers of financial markets. They still are in **Big Brother**, however, they have been nationalized to serve the national payments system. Leveraging their existing knowledge and expertise.
Financial stability	Economically, counties can become stable. As the government has substantial control over the payment system, aspects such as inflation control and economic policy have a great effect. For example, the government can issue an amount of money to its citizens that need to be consumed. However, the idea of financial stability seems hard to comprehend with a national payments system that is governed by the government with fires that need to be extinguished.
Legal	
I just follow the rules, don't make them	There is a perspective of low accountability, as the government has everything figured out. Further, there is a feeling of incredible strength and status of the governments' systems, there is no point in going against them or trying to discuss them.
Tech rules are law	The rules that are created to develop and maintain the national payments systems are constituted in the law.
Much work for lawyers	Due to the extensive and detailed legislation surrounding the national payments systems. Every update, change, or innovation developed for this system needs to be checked by a long and extensive legal process. As well for citizens, trying to rectify mistakes in the national payments system will take enormous amounts of administrative (digital) paperwork.
fiat is made "illegal"	Due to the increase of CBDC payment options, there is less need for fiat-based currencies. Hence, the old-fashioned fiat currencies are being down-scaled and eventually made illegal to use.

Table 17: Analysis of scenario 4 descriptors part 1

Descriptors	Analysis
Social	
Consumer and investor protection and trust + happy state	As there is detailed and extensive legislation surrounding the national payment system, it seems that the system is safe. Resulting in trust for the users, people are feeling due to the legislation in place. Yet, having a legal framework is one thing and enforcing it is something else.
Is crypto vegan and gluten free	People do not care about what it takes to get the benefits and results. As vegan and gluten free alternatives are healthy choice from a food perspective, environmentally they might not always be the best (avocado's). This mindset is also in place for the national payments systems, people want something that works and seem to have the values they care about.
Sharp generational distinctions	There will be people knowing the world before this **Big Brother** and also the risks of this world due to unpleasant historical events. This might create two or more political streams due to the opinions of the voters.
Technological	
Limited/ killing innovation	There will be big entrepreneur buildings to create innovative solutions. However, these will be without real innovation, probably only incremental innovation. As there is a fixed set of legal conditions to surpass, disruptive innovations have low chances of going through this legal path. This is also the case for pilots or experiments, meeting the requirement to test in real life are so hard, the endeavours are too costly.
Interoperable systems + track & trace	The applications of the government that make up the national payment system are interoperable. However, this connectivity leaves room for track & trace of payments in the system. Everything can be monitored or triangulated.
Backdoor for government resulting in security breaches	A big risk is a security breach. It is not a matter of "if" but "when". Once someone is deeply invested in system, it can have serious complications. Especially regarding the important public values for the users. As every citizen is linked to this system, the consequences are unimaginable. Similar small-scale examples have already presented themselves of public systems that have been involved in leaked data (Schellevis, 2021).
Environmental	
CO2 neutrality enforced	As there are major climate issues in 2030, the government has create a blockchain-based system with a consensus mechanism that aims to have a low carbon footprint and utilized clean energy to power the systems.

Table 18: Analysis of scenario 4 descriptors part 2

4.7.4 Scenario 4 - Big Brother Narrative

With the analysed descriptors, presented in Tables 17 and 18, the essence from PESTLE domains can be described in some focal points. The PESTLE-based focal points are merged into one coherent and overarching scenario narrative, complemented with visuals, presented in Figure 28. The images used in the scenario narrative are respectively Sorokin (2022)[6], Darwish (2020)[7] and AsiaBlockchainReview (2019)[8].

[6] from "Central Bank Digital Currency or CBDC. Isometric Financial Concept with Scheme of Interaction between Central Bank and Commercial Banks", Image ID:2J3XXE1, by Sorokin (2022) (https://www.alamy.com/central-bank-digital-currency-or-cbdc-isometric-financial-concept-with-scheme-of-interaction-between-central-bank-and-commercial-banks-blockchain-image467115433.html)

[7] from "Global Pandemic Heightens the Shift Towards CBDC" by Darwish (2020) (https://www.progressoft.com/blogs/global-pandemic-heightens-the-shift-towards-cbdc)

[8] from "BLOCKCHAIN: Governing the Government" by AsiaBlockchainReview (2019) (https://www.asiablockchain-review.com/blockchain-governing-the-government/)

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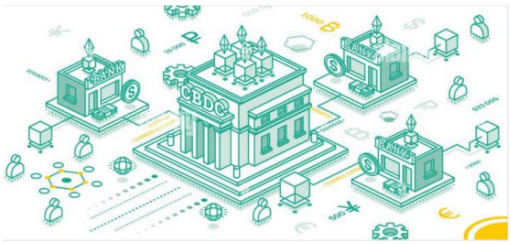
Big Brother

Shivaye Jagesar



This scenario sketch represents a combination of "State incentivized CBDC" and "Strict/ detailed/ comprehensive regulation". This scenario is driven by a national blockchain-based payment system, which is diffused country-wide and controlled by a government.

Political

The national payment system is being developed and maintained by the public. This system will form the backbone of the payments system in the financial markets, with the promise of safe and reliable systems. The payment options will consist of a set of CBDCs. During development and maintaining the system, public values are pursued and enforced, such as privacy, safety, reliability, and sustainability.

Economical

Financial crises are in the horizon as politicians are not able to govern the system. They are facing challenges they have never encountered before. By nationalizing the traditional banks, they can leverage some existing knowledge and expertise on the matters. Nevertheless, financial stability is questionable. Yet, the potential is there, as the government has substantial control over the payment systems.

Legal

The legal position of the government is so strong, that people just follow the rules and are not even try to discuss them. The rules for developing and maintain the national payments systems are constituted in the law. Hence, trying to add innovations and changes in the national payment system is a legal nightmare, taking a lot of hours from lawyers. As the CBDC are increasing in use, the old-fashioned fiat currencies are being downscaled and eventually made illegal to use.

Social

People only care about the benefits, the potential risks are neglected. People are happy, as the government has everything covered. There is detailed and extensive legislation surrounding the national payment system, it seems that the system is safe. Resulting in trust for the users of the system.

Technical

As there is a fixed set of legal conditions to surpass, disruptive innovations have low chances of going through this legal path. Technical innovations are mostly incremental. Every organization linked to the operability of the national payment system must allow the government access to its applications and systems. Due to the interoperability of every application, monitoring of currency flows is possible. Well, who will be watching us?

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Figure 28: Big Brother Narrative

4.8 Concluding Remarks Chapter Four

This chapter represents the first activities of qualitative data collection from participants. This data collection was necessary for developing scenarios in order to reach the first part of the research objective and answering sub research question 3 (SRQ3), "What are possible scenarios of blockchain for the payments industry?". The qualitative approach was guided by the scenario-based roadmapping method of Hussain et al. (2017), which in turn is backed by the book "Scenario Thinking" from Cairns & Wright (2017) and the roadmapping approach of Strauss & Radnor (2004). Based on this methodological backbone, a workshop scenario is designed in order to develop scenarios. The workshop follows the steps; setting the scene, impactful driving factors, uncertainties, scenario framing and scenario development. Thereafter, scenario narratives are developed to provide a coherent and overarching story regarding a future outlook.

SRQ3, "What are possible scenarios of blockchain for the payments industry?" is answered in this chapter by presenting two scenario narratives, namely, **Techno-verse** and **Big Brother**. Each scenario is based on a scenario frame constructed with two extreme situation of the most impactful and uncertain driving factors. The driving factors are governance and regulation, each with two extremes, law of the jungle versus state incentives CBDC and libertarian versus strict/ detailed/ comprehensive regulation, respectively. Scenario **Techno-verse** represents a combination of "law of the Jungle" and "Libertarian". It is driven by BigTech dominance and the digital/ technology entities that are ruling. Given that Blockchain is everywhere, the world revolves around web3 and other blockchain applications, resulting in an ecosystem where there is no place for a traditional bank because everyone can become a bank. Scenario **Big brother** represents a combination of "State incentivized CBDC" and "Strict/ detailed/ comprehensive regulation". This scenario is driven by a national blockchain-based payment system, which is diffused country-wide and controlled by a government. This system will form the backbone of the payments system in the financial markets.

In the next chapter, roadmapping activities are conducted, based on the developed scenario narratives from this chapter. The next chapter is the final chapter with new data collection and analysis. Based on the information gathered in the next chapter, the research project can be concluded and the main research question can be answered.

5 Scenario-based Roadmapping

The objective of this chapter is to develop pathways through roadmapping to answer sub research question 4 (SRQ4), "Which strategic pathways prepare financial institutions in the payments industry to address blockchain development?". The developed scenarios will first need to be evaluated. This evaluation is utilized for creating strategic pathways. Thereafter, flex points are identified that can potentially result in pivotal shifts in a pathway. Finally, pathways and flex points are condensed in a multi-scenario roadmap. This multi-scenario roadmap is an answer to SRQ4. The chapter starts with a short description of how the research design for roadmapping is constructed. Followed by an evaluation of the scenarios, creation of the pathways, identification of the flex points, and development of the multi-scenario roadmap, which in turn answers SRQ4.

5.1 Research Design - Roadmapping

With the developed scenario narratives, the construction of the roadmapping activities can start. First, the developed scenarios need to be evaluated in terms of implications for society, industry, and corporate organizations. Due to the influential role of the government in blockchain developments, the impact on the governmental implications is analyzed as well. Second, pathways towards the scenarios need to be constructed, provided by an adapted technology roadmap (Hussain et al., 2017), presented in Figure 29.

	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties				
Internal Business Strategy				
Product/ Service/ System				
Technology				
Resource				

Figure 29: Technology Roadmap provided by Hussain et al. (2017)

Once the architectural framework of the technology roadmaps is synthesized, they can be considered pathways. Once the pathways of the scenarios are developed, identification of the “flex points” can start. Flex points are key potential developments in the environment of the study. These potential developments could have a significant impact on the evolution of the technology (Hussain et al., 2017). If the pathways are constructed and flex points are identified, a multi-scenario roadmap can be created. This roadmap shows various routes to different future outlooks and pivotal points which allows for shifts in strategy over time.

Due to the need for internal consistency between the necessary steps of the scenario-based roadmapping, the roadmapping phase is based on logical thinking and feedback loops. Most rows can be filled in with the analysis from the reviewed literature and by the collected data from the workshop. This process is linked to logical thinking. Feedback loops are used to validate the results from these logical thinking activities. These feedback loops are based on incorporated qualitative input from interviews. This process is repeated for the scenario evaluation, construction of strategic pathways, and identification of flex points. These feedback loops consist of various interviews, preferably with participants that already were invested in the scenario development process to keep the consistency.

A total of six interviews have been conducted, three participants were also participating in the scenario development workshop. The other three participants are not familiar with the scenario development process, thus, an introduction to that process was necessary before diving into the roadmapping interview. The data management plan, interview protocol, and analyzed interviews are presented in appendix C.

5.2 Evaluating Scenarios

Before diving into the analysis and feedback loops, it is beneficial to understand the steps that are taken in this chapter that will finally result into the multi-scenario roadmap. The previous paragraph has already elaborately discussed how this takes place, however a visual overview help to comprehend the discussed information, as presented in Figure 30. This paragraph focuses on scenario evaluation.

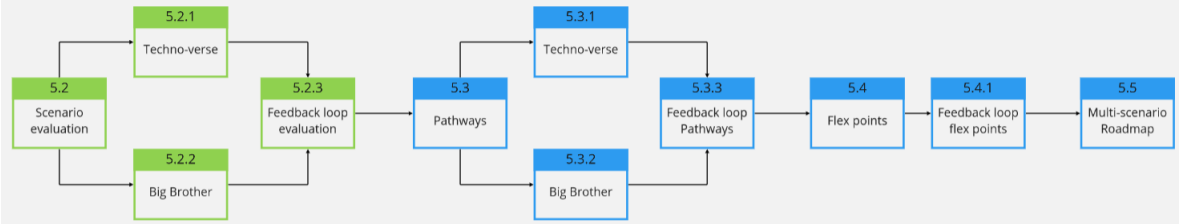

Figure 30: Roadmapping steps - scenario evaluation

A proper evaluation of the scenarios is necessary to create pathways. The scenarios only provide snapshots of possible future outlooks, not what the implications and impact are on a (eco)system-wide perspective. The scenarios are discussed and particularly their impact on industry, organization, and society (Hussain et al., 2017). This scenario analysis provides leads that are used to further synthesize the information necessary to construct the pathways. Due to the influential role of the government in blockchain developments for the future, based on the literature review and scenario development workshop data, the impact on the governmental implications is analyzed as well.

5.2.1 Techno-verse

Governmental Impact
The **Techno-verse** disruptively affects the role and impact of the government. Politicians are being persuaded by BigTech organizations and make decisions based on the lobbying and benefits of the BigTech organizations, especially the countries that are profiling themselves as favourable countries to establish the headquarters of the BigTech organizations. These fast-changing and adaptive ecosystems of payments organizations and systems confuse politicians, resulting in a broad spectrum of political parties with each their perspective. These ecosystems are growing broader with the increase of asset digitalization and many different competing initiatives offered by the BigTech organizations. Yet, most politicians are influenced by the substantial power of the BigTech organizations in terms of election results. Furthermore, fiat currencies are losing dominance in the payments market, resulting in fewer economic instruments to control financial stability for governments. The power continues to grow as more and more people use the systems of the BigTech organizations. The rise of P2P banking is a positive influence on the individual level, however, as a collective group, the dependency on these organizations grows. New entrants and entrepreneurs are no match for the BigTech organizations. Penetrating the payment market is nearly impossible, the large network externalities that need to be overcome present barriers that are not easily surpassed. Even if the government of politicians would like to attempt to stop the BigTech organizations, their reactive regulation is always chasing after the facts. Hence, the power of BigTech organizations grows to unprecedented heights, shaping this scenario as a real **Techno-verse**.

Industry Impact
The payments industry has shifted from a fiat-based and physical nature to a commodity-based and digital environment in the **Techno-verse**. Industry-wide shifts are in progress. BigTech is increasingly becoming dominant as leading organizations in the payments sector, replacing the role of traditional banks in the payments markets. There are various payment systems and applications, each offered by different BigTech organizations, however, interoperability is second nature. This is leading to consolidated powerful dynamic networks of payment options hosted by BigTech organizations. The payments market boundaries are becoming more fluid due to asset digitalization, physical ownership is simplified in terms of the transactional perspective. As the BigTech organizations are leading in the payments industry, a combination of various domains will be offered, such as Metaverse platforms, social media platforms, online retail, and payments applications to use on all the platforms.

Corporate Impact
BigTech and banks of the future need to change from an organizational perspective. The organizations

that have survived the big leap of BigTech need to diversify their portfolio of financial products and services or completely focus on specializing in a select portfolio of financial products and services. Various organizations will not survive the big leap, either due to too slow response that resulted in missing the boat or being bought in (hostile) take-overs by BigTech companies. Interoperability is second nature, nevertheless, most BigTech organizations and surviving banks have isolated systems in essence as data is gold in the **Techno-verse**. Due to a large amount of necessary computation power to run these systems, the users can offer their computational power for compensation. The organizations in this payments industry are only focused on incremental innovation, as there is little real competition among the ruling BigTech organizations. Besides, risking to develop and implement disruptive innovations in this environment can become a kamikaze operation.

Societal Impact
Like any other blockchain system, without society, there is no large-scale successful blockchain system. Financially, the world is quite stable. Cryptocurrencies of the past have lost their value because BigTech could not influence those applications to their strategic plans. However, BigTech organizations have created P2P systems for people to exchange with each other. Individually, people can thrive. There is an (extreme) individualism in society, a way of life that represents itself as freedom, however, it results in selfishness. This mindset contributes to the fact that numerous people are not participating in this new ecosystem of payment applications. Poor people who cannot afford a phone or proper internet are not able to keep up with the fast-changing developments and are left out. The general society has no idea about this, due to their individualism. This is also the case for non-technical people with very low levels of digital literacy. These people are eventually being pushed from the skilled labour market, as they have no access to the BigTech payment platforms.

The general public can exchange their computational power with BigTech if they desire. Work, school, and entertainment are more pushed towards the digital environment, resulting in massive data collection. Also, the customers of the future, children, are indulged in digital ecosystems. There is also a big influence of BigTech in schools. Once a child is hooked to a certain system, switching costs are high and chances are that these children will become customers for life. Having extensive data of so many people requests the data mining of individuals to be powered by individuals, ironically. This much data in such a large-scale and connected system might also encounter great security threats. Threats that are not even imaginable now. Customer protection is something strange in the **Techno-verse**. There is a high information asymmetry for an user, BigTech organizations are in an unclear legal framework and there are highly automated systems. Finding out where something went wrong will be quite a challenge, then proving who is responsible and accountable will be even harder.

5.2.2 Big Brother

Governmental Impact
Big Brother is shaped by the government, as there is one large-scale blockchain-based national payment system. As means of payment, CBDC is the new form of standard accepted currency. Each citizen has a digital wallet linked to a type of social security number. The government can be seen as a BigTech organization that offers a platform for payments. As the national payment systems are linked to a social security number, people are not left out, except for the few people who are under the radar of the government. The system can be viewed as a democratic system in its essence. The citizens of a country have voted for politicians, each with a set of values. The leading political movement will develop and maintain the national payment system with this set of values in mind, the public values. The best guesses are in the realm of privacy, safety, reliability, and sustainability. Budget and subsidies will in turn be guided toward developments that are in line with the public values. Nevertheless, this national system will come at a cost, citizens can be monitored and privacy boundaries become vague.

Most organizations that are involved in the payments market are state-owned. The rules that are developed for aiming toward the public values will have legal bases and laws will be created that cover these technical rules. A national payment system will put great challenges and complex issues on the government and the politicians. There will be various problems to solve, once one is solved, another one arises. Also, problems that have never presented themselves need to be dealt with. These problems can result in financial instability and financial crisis. However, the potential is there to create financially stable economies. As the government has substantial control over the payment systems, aspects such as inflation control and economic policy have a great effect on a national payment system. For example,

the government can issue an amount of money to its citizens that need to be consumed. This can be a business rule-based system, e.g. backed by smart contracts, that people must use a certain percentage of their government-issued subsidies on certain stores to meet their inflation or economic policy goals.

Societal Impact
Public values are centred in **Big Brother**, and the voice of the people is reflected in the politics and thus also in the national payment system. Citizens are happy and feel protected, they just follow the rules and don't worry about the potential risks. Why should they worry? The government has everything fixed within the values they desire, everything seems vegan and gluten free. Yet, there is a group that consists of the older generation that knows the risks of a completely government-owned system and is feeling a little anxious. Nevertheless, politicians are trying to incorporate their worries into the development of the national payment system. They have even constituted it in the law!

Nevertheless, having a legal framework and enforcing it are separate things. The government can easily monitor its citizens without them knowing, but also it is hard to prove what is considered operational activities and spying. Hence, privacy is vague in **Big Brother**. The private cryptocurrencies have been abolished, and only the CBDCs from the government is accepted as standard payment.

Industry Impact
The payments industry in **Big Brother** has almost been completely nationalized (government-owned). Organizations that are dealing with the operational and development of the national payment system are heavily regulated and are aimed to reach the public values. Internal resources and subsidies will be shifted into reaching the public values. Some organizations are not completely nationalized, however, they must bend toward the demands and wishes of the government as their payment system has a monopoly on the payments markets in terms of transactional activities. Trying to be innovative, results in great legal administrative work to prove that the additions or changes in the national payment system will reflect the public values or help reach them in a certain way. Resulting in an industry's need of skilled people with a legal and technical background.

Corporate Impact
The nationalized organizations have changed in a disruptive manner compared to the traditional banking organization that used to rule the payments industry. Their strategy is purely focused on pleasing their only client, the government with their national payment system. However, some activities remained in the hands of the now-called nationalized banks. The traditional banks were the gatekeepers of financial markets. They still are in **Big Brother**, however, they now serve the national payments system by leveraging their existing knowledge and expertise, for example with anti-money laundering (AML) activities. All the participating organizations need to have interoperable systems and applications, as they need to form one large-scale national payment system. Yet, disruptive innovation among the participating organizations is not being developed, as there the risks are too great to pursue such an endeavor. The government must also have access to every application and system, this backdoor can create significant security issues once unwanted guests can enter the national payment system.

Now that both scenarios are evaluated by logical thinking, validation of this analysis is necessary. A feedback loop based on interviews provides this validation. This activity is discussed in the next paragraph.

5.2.3 Feedback Loop - Scenario Evaluation

The first feedback loop regarding roadmapping is for the scenario evaluation. Two questions are asked in this first phase of interviewing. After introducing the scenarios, "Do you think that the scenarios reflect the development frames?" and "What scenario would you consider the most plausible? And why?". Summarized responses per question, per respondent, can be found in appendix C.3.1.

First Question
Regarding the first question, "Do you think that the scenarios reflect the development frames?", most respondents agreed that both scenarios reflected the development frames. Respondents that were not familiar with the scenario development frame and the process of creation for the scenarios got an explanation before asking this first interview question. What is noticeable is that the Techno-verse has a more firm and clear response to the question compared to the Big Brother scenario. It can be seen as

more consensus on agree-ability for Techno-verse than for Big Brother. some interesting comments are presented in the following two lists of comments.

Techno-verse

- Geopolitical will be an issue.
- I don't think that there will be constantly fishing behind the net by the politicians
- BigTech has now freedom of speech as a counterbalance act for their social platforms, no sure what that will be the counterbalance for the payments area.
- People will always try to govern/ regulate the situation, law of the jungle will be hard to remain.
- Not sure if blockchain is everywhere, could also be not blockchain that is everywhere, but some other technology. Could also be that digital banks become dominant, they already exist in some form and not blockchain-based possibly.
- For the social aspects, there can even become a potential wealth divide.
- Not quite sure if people that have unstable internet connection will get left out. We can still do business in this day and age if your internet is not stable. Regarding digital literacy, people will need to go through more hoops but not left out, they will struggle.
- The threats that are not even imaginable right now in technical, quantum computing is an interesting example. A threat can also be bigger impact if the systems are compromised. Another threat could also even be the large energy consumption, how to deal with sustainable energy – safeguards for energy if we go solar and wind.

Big Brother

- It is quite hard to regulate because the whole idea is that you can't regulate it, it's decentralized.
- A national blockchain-based payment system that is diffused in a country and controlled by a government. Types of governments in different countries are different.
- It's a mistake to think that public value can only be created by public organizations.
- Politicians are not able to govern the system. But in such cases, politicians typically hire experts who can design effective strategies to deal with issues.
- When the money supply is coded, monetary policies such as quantitative easing and tightening become much easier/ different, with so many more ways in manipulating the market than the instruments now available. Also, their policies now take months to happen, with the new blockchain system, it is instant, and not sure about financial instability.
- BigTech might shift due to the political systems as well. Banning private blockchain initiatives is a prisoner's dilemma. Every country has to do it, otherwise, companies will just go to other countries. This can lead to the effect of loosening regulation again, and to get them back or persuade them to stay.
- Take into account that older people that are not tech-savvy. They might lose their trust in the government as well. It is a bit too far when you say that all people are happy and everybody trusts.
- Who has the technical knowledge? Those will rule the world, you could say in a technical sense.

The comments on the scenarios themselves are taken as feedback. There is no necessity for changing the scenarios, as changing the scenarios might fundamentally change the pathways.

Second Question
Furthermore, the question "What scenario would you consider the most plausible? And why?", was asked to get a starting direction for the roadmap that are developed later in this chapter. This question resulted in very divergent answers, which makes it hard to get a consensus on which direction to pick for the start of the roadmap. The biggest commonality in the responses is that respondents were asking or commenting regarding the political system of a country, or to which geographical area their answers

must be bound. Unfortunately, there is no scoped geographical boundary in this research project, it is a high-level perspective research project. This geographical perspective, political systems, and geopolitical situations can be addressed in future research.

After some necessary follow-up questions to get an overall direction of where developments might bend to, again, divergent answers. Three respondents are following the Big Brother direction and two responded follow techno-verse during the start of the roadmap. Two responses for Big Brother are:

"politicians always react on events, then the take action. You got to extremes when something happens, they do too much. You go from one extreme to the other. But I think the tendency we will be to be more strict." and *"Big Brother is already there, while Techno-verse is not yet, in that sense it might first bend that way. I'm not sure if there is any place in the world where there is such little regulation as the Techno-verse scenario"*

While the argumentation for the Techno-verse is described below from one respondent:

"Techno-verse. Definitely. Overwhelmingly, so I'd say. but not necessarily, with a certainty that blockchain will be in it, but definitely the environment that you have sketched. Because I think there's already a lot of places where you see that's happening."

Big brother will be used to start the directional path of the roadmap, as three responses are bending toward Big Brother and two responses are bending towards Techno-verse. During the scenario development workshop, quick voting was conducted to establish the most plausible scenario as well. In this voting, a strong state also got the majority, see Appendix B.6. Some respondents also mentioned that it might end up somewhere in the middle, these comments are taken into account during the development of the multi-scenario roadmap.

5.3 The pathways

This paragraph focuses on the next steps in reaching the multi-scenario roadmap, namely, the construction of strategic pathways. These steps are presented in Figure 31.

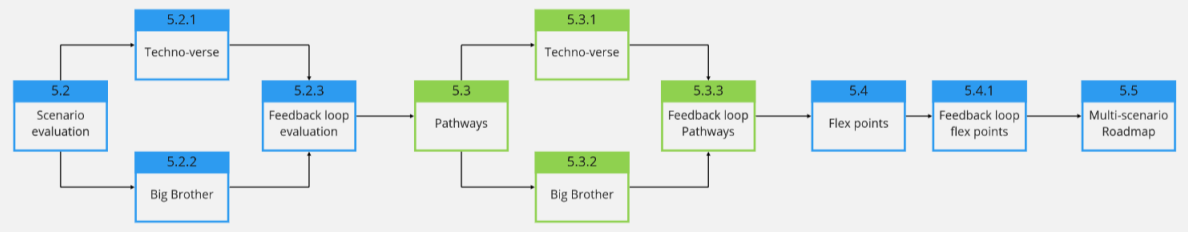

Figure 31: Roadmapping steps - pathways

Based on the evaluation of the scenarios, literature review, and scenario development workshop data, strategies need to be developed from the perspective of the financial institution active in the blockchain space. These strategies are developed in reaction to external market developments and uncertainties in four different planning horizons (years 1, 3, 8, and vision). This allows for alignment with each of the future outlooks described in the scenarios (Hussain et al., 2017). To create an overview of the contents, an architectural framework called technology roadmap is used, presented in Figure 32. External market developments and strategies are the first two rows of this technology roadmap. This top layer represents the trends that determine the overall direction associated with the pathway construction (Hussain et al., 2017).

There are three more rows in this technology roadmap. The subsequent rows concern Product/ Service/ System and Technology, these rows capture the general applications of blockchain in the payments industry. As blockchain is a high-level technology, not a singular product or application, key areas of development and deployment of blockchain in the payments industry are presented in a high-level description. This middle layer relates to the tangible systems and technological developments that respond to the described aspects from the top layer. Usually, this middle layer is linked to the evolution of products

	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties				
Internal Business Strategy				
Product/ Service/ System				
Technology				
Resource				

Figure 32: Technology Roadmap for pathway contents provided by Hussain et al. (2017)

or services (functions, features, and performance), however, due to the high-level nature of this research project, this might be a bit more abstract. Nevertheless, the middle layer can also be used to describe developments regarding infrastructures, services, or other mechanisms, such as knowledge, integrating technologies, and capabilities (Hussain et al., 2017).

The last row in the technology roadmap is regarding the resources necessary to develop the path aimed at reaching a future outlook. As Hussain et al. (2017) described, "The bottom layer relates to the resources that need to be marshaled to develop the required products, services, and systems, including knowledge-based resources, such as technology, skills and competences and other resources such as finance, partnerships, and facilities" (Hussain et al., 2017, p. 163).

During the evaluation of the scenarios, the impact on government, industry, corporates, and society was identified and created a glimpse of the vision and late technological environment. For the late horizons, the technology roadmap could already be filled in based on that impact analysis. The other time intervals are synthesized with logical reasoning, based on the literature review, as that depicts the current and near-future developments and barriers of blockchain in the payments industry. Eventually, the pathways present a timeline for the following years, yet, these are not probabilistic predictions but just mere fluid directional steps in the future. The exact years should be taken with a grain of salt.

Some interesting statements from the literature review can already be taken into account for both pathways. As Bateh (2019) noted stating the impact of blockchain by 2030, is expected to disrupt the traditional financial organizations. The expectation is that the leading organizations will set the standards and way of working. So, for either scenario, it is necessary to pick the leading organizations and how they would drive the developments to each scenario, with in mind the impact on the financial institutions. What is interesting, as (Zetzsche et al., 2020) added, the rapid growth of blockchain development continues to increase while other aspects of blockchain development lag behind, e.g. governance and legislation. This growth highlights that the development of blockchain is faster than the time financial institutions and decision-makers need to estimate and evaluate them. Lastly, the current competitive environment in the payments industry is still active, resulting in the continuation of pilots and experiments of private and public blockchain initiatives for both pathways. This section focused on commonalities, the following paragraphs are evaluating scenario-specific aspects.

5.3.1 Techno-verse

External Market/ Uncertainties
Techno-verse is depicted as BigTech ruling the payments industry with their blockchain initiatives. However, this is the vision, the first step to getting to such a vision is the introduction of blockchain-based products and services into the payments market. As presented in the introductory chapter, some initiatives are happening, yet, not picked up by financial institutions or other large organizations such as BigTech companies. This trend has also been recognized in the literature, with a hesitant attitude against blockchain implementation. Hence, there are opportunities for BigTech companies to grow and extend their current portfolio to the payments industry. With the growth of these initiatives, lobbying starts to protect these new digital payment applications issued by BigTech organizations. Even leading to moving their headquarter or legal entities to countries that protect and help these blockchain initiatives grow. Moving further in time to 2030, BigTech organizations have quite a network of users, hence, increasingly political power as well. Due to this power, legal frameworks are unclear and bent in favour of BigTech organizations. These developments are shown in the top row, in Table 33.

Techno-verse	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties	As there are no large-scale and widely accepted private blockchain initiatives for the payments industry, BigTech sees opportunities to extend their portfolio of (financial) products and services	Lobbying of BigTech starts on a large and global scale in order to keep the issues digital currencies Countries are profiling themselves as favorable business climate to host a large payment system	BigTech organizations have increasingly more political power due to their reach to the public Legal frameworks are kept unclear and bent to the will of BigTech organizations	BigTech rules
Internal Business Strategy	Financial institutions see opportunities to collaborate with BigTech organizations (opportunistic strategy)	Numerous private large-scale bigTech-issued currencies (winner-takes it all strategy) The BigTech are making the entry of barrier for users as low as possible Cutting loose from fiat	BigTech organizations are specializing in certain areas to establish dominance there. However, their collaboration with each other result in complete dominance in the payments industry (oligolopic strategy) Financial institutions are either leaving the payment industry or will be taken over by BigTech organizations	Financial institutions are no longer active in operational activities for the payment industry, other financial products and services are the focus
Product/ Service/ System	Various pilots and experiments private blockchain initiatives for the payments industry	Various networks of blockchain based application are guided by participating financial institutions Design requirement of further developments are in line with private values	The payment system id governed by a few BigTech organizations Switching costs for users are high, leading to constant high network externalities	Various large-scale blockchain based global payment application that form the new backbone of the payment industry Develop a system with private values in mind
Technology	Various different private blockchain projects are being presented The public agencies are starting with pilots and hinting towards planned CBDC release	P2P financial products and services are being introduced Introduction of new blockchain based products and services, e.g. metaverse platforms	Mining of users is being utilized for the systems of BigTech organizations, as the need of more storage and computational power is increasing Digitalization of physical assets, making them easier transferable and more portable	Develop a technology with private values in mind Even with the interoperability, the systems are in essence isolated to their respective BigTech organization
Resource	Allocated teams will assist BigTech in building a proper financial product and supporting services.	Massive amount of human and monetary resources are being spend in development and marketing in order to grow the network of users	Massive amount of human and monetary resources are being spend in development of the relative new products and services, e.g. metaverse (for the financial institutions left in the payments industry)	The traditional banks are forced to become more ICT-oriented to keep with the developments of BigTech. They are no longer at the center of the payments industry.

Figure 33: Pathway - Techno-verse

Internal Business Strategy
Based on the external market conditions that are described, the financial institutions need to react and use strategies. First, as the literature described, there is a fear of missing out present in the payments industry. Financial institutions are willing to collaborate with BigTech organizations due to the opportunistic outlooks. However, due to the fast growth of the combined BigTech and financial institution initiatives competition between the applications/ platform is increasing. Some initiatives are even cutting loose from fiat currencies, trying to create their monetary ecosystem. speeding to 2030, the remaining BigTech organization are forced to specialize in an area to remain dominant in a certain area. Yet, due to their collective interest, their ecosystems are in a sense interoperable. Financial institutions that were not part of the collaborations earlier described are either leaving the payments industry or will be taken over for their users or potential competitive advantage. Leaving the traditional financial institutions no longer in charge of the payments industry, as shown in the internal business strategy layer of Table 33.

products/ services/ systems, Technological advancements, and Resources
These developments and strategies are characterized by the following products/ services/ systems, technological advancements, and resources. First, in the near, future pilots and initiatives will start, both from the private and public sectors. However, in the BigTech organization, dedicated teams will be created to develop and grow these pilots further. Taking it to a mid-term view, there are now various large ecosystems and they are developed and will continue to do so, with the BigTech values in mind. New products and services will be presented to all the users such as P2P applications and the payments applications will broader their usage, for example, connections to the metaverse. At this point, a massive amount of human and monetary resources are dedicated to these blockchain-based initiatives. Moving to 2030, as one of the participants mentioned in the scenario development workshop, when types of currencies start flowing into a project/ platform, they will be used if such a platform evolves further. This allowed the BigTech companies to cut loose from fiat currencies, but also to keep switching costs to other ecosystems high. This allows the BigTech organization to remain powerful and makes it hard for a new organization to penetrate the payments market. The ecosystems are in a sense interoperable, however, the essence is that each BigTech organization has an isolated system, creating a large payments market with a few BigTech organizations that can govern it.

5.3.2 Big Brother

External Market/ Uncertainties
Big Brother is depicted with the government as the ruling entity. As the literature currently suggests, a well-known example of a social challenge is the reports of stolen cryptocurrencies. This is often illustrated in the literature as financial fraud, scandals, commercial fraud, or scams. These negative-oriented blockchain events are pressing the need for short-term regulation, thus, politicians are trying to the privately hosted blockchain initiatives. Leading to regulation in the mid-term that makes privately issued blockchain initiatives obsolete. A national payments system is brought to life and developed over the years, however, in the long-term, financial stability is at risk due to unforeseen consequences. Politicians do not know how to properly govern such a system and over the years there is a complex and detailed legal framework that makes it even harder to comprehend and govern the entire system. These external market conditions are depicted in the top layer of Table 34.

Big Brother	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties	Politicians are trying to regulate the current private blockchain initatives for the payments industry Due to more negative-oriented blockchain related events, the public and media presses the need to regulation	Regulation that makes private blockchain initiatives obsolete for the payments industry	Financial stability is at risk due to unforeseen consequences of the national payment system There is a complex and detailed framework.	Government is ruling
Internal Business Strategy	Working in consortiums, private and public in order to not miss any opportunities (Hesitant strategy)	Numerous public-private partnership (oligopolistic strategy) Current customers of financial institutions can easily switch to a digital CBDC wallet (utilization of network externalities)	Let the government become a shareholder of the financial institutions (survival strategy) Mandate (partly) state-ownership of the government for participating financial institutions	The strategy of surviving financial institutions is purely focused on pleasing their only client, the government with their national payment system.
Product/ Service/ System	Various pilots and experiments of public and private blockchain initiatives for the payments industry	Create one network of participating financial institutions Design requirement of further developments are in line with public values	Centrally governed system Backdoors are created for the government Enforcement of legal framework is not manageable	one large-scale blockchain based national payment system Develop a system with public values in mind
Technology	Various different private blockchain projects are being presented The public agencies are starting with pilots and hinting towards planned CBDC release	Maintain and increase high troughput system for state-offered CBDC Digital wallets for citizens	Monitoring of transactions Society picks up the national payment system, large amounts of data need to be stored and processed Digitalization of physical assets, making them easier transferable and more portable	Maintaining and developing the technological advancements with public values in mind
Resource	Knowledge hiding is still quite active. Monetary resources are being kept limited, as the business gains are still unclear	Share the compounded knowledge in the public-private collaborations Becoming a public partner will create oligopolistic incentives to invest in the CBDC development	Subsidies of the government will be allocated to the remaining financial institutions that have been (partly) nationalized There is dedicated departments at financial institutions for maintaining and development of the national payment system	The traditional banks are still the gatekeepers of financial markets. However, they now serve the national payments system.

Figure 34: Pathway - Big Brother

Internal Business Strategy
The internal business layer is first characterized by working private and public consortiums, leading to numerous public-private partnerships that can be seen to take the form of an oligopolistic strategy. By taking this approach, the current customers of the traditional financial institutions have the opportunity to easily switch to a digital CBDC wallet. Creating a relatively quick hype and fast growth of network externalities. Taking things to 2030, the national payments system has become the backbone of the financial markets, and the standard for the payments industry. Due to this immense system, the government needs to take part-ownership in the financial institutions that are assisting in the development, monitoring, and maintenance of this system. The financial institutions go into a survival strategy and let the government nationalize them or become part-owners, as the government is their biggest client.

products/ services/ systems, Technological advancements, and Resources
These external events and strategies are characterized by the following products/ services/ systems, technological advancements, and resources. In the short term, pilots are started of both public and privately initiated blockchain initiatives. There are rumours of high interest in CBDC from the government agencies. In the public space, knowledge hiding is slowing developments down, resulting in limited resources, the business case is also still unclear, as extensively described in the literature review. Moving on to

the mid-term, the government is so fond of the CBDC idea, that they create legislation that makes private-initiated blockchain applications obsolete for the payments industry. The early CBDC pilots are considered a success and one large network is created for setting up the large-scale CBDC with the help of the financial institutions. Development of this new payments system is with the public values in mind, digital wallets are fast available for citizens due to the release of knowledge in the industry regarding blockchain systems, as there is now one large initiative. There is a chance of doing business with a government, with an oligopolistic outlook. In 2030, the national payments system is widely used and centrally governed. The participating financial institutions have backdoors for the government which allows for monitoring of transactions. Soon, other (physical) assets are also transferable with this system, increasing the portability of assets. Further developments of the system will go in the direction of intended subsidies. As described in the literature, a focus on public values, e.g. societal ills in the form of financial-related crimes such as money laundering, drug trafficking, illegal immigration, and potentially eradicating the costs of (physical) cash handling, but also previously described as negative-oriented blockchain events. Leaving the traditional financial institutions to still be the gatekeepers of the payments industry, however, now for the national payments system. These paths are presented in the bottom layers of Table 34

5.3.3 Feedback Loop - Pathways

The second feedback loop regarding roadmapping is for the pathways. Two questions are asked in this second phase of interviewing. After introducing the pathways, "Do you agree with these paths towards the scenarios? What should be changed or is something missing?" and "Are the allocated time intervals in the pathways realistic from your perspective?". Summarized responses per question, per respondent, can be found in appendix C.3.2.

First Question
For this question, "Do you agree with this paths towards the scenarios? What should be changed or is something missing?", a list with comments is presented. This created an overview per column on what has to change in the pathway regarding the contents. First starting with the Techno-verse and thereafter Big brother.

Techno-verse

- External Market

  That BigTech get more trusted at one state, e.g. Facebook's currency will be more trusted than the Euro.

- Internal Business Strategy

  Financial institutions will be holding up to their market power - market privileges.

  Why google has a banking license in Estonia and they can use it in the EU. I think you should show that BigTech tries to circumvent regulation.

  Cutting loose from fiat seems not likely, e,g, these banks in NL all fall under De Nederlandsche Bank (DNB), and they followed their regulations. However, maybe it can happen later.

- Product/ Service/ System

  Perhaps move and add the new services (digitalization of physical assets) to the product/ service/ system row instead of technology

  Governance is a big challenge for blockchains.

- Technology

  Interoperability might play a role, you see now in the discussions with the metaverse.

  Perhaps add "innovative" to P2P products that are not regulated.

  Describe the public/ private BC initiatives better, they can now be confused with BC architectures.

- Resources

  Show that BigTech needs to get critical mass, sufficient users.

  Also, the current we have a shortage of expertise (technical) personnel, and demand for knowledge.

One of the participants did want to mention something regarding the differences between the two scenarios:

"Maybe the Techno-verse might have a timeline that could be shorter than Big Brother. Big Brother will come across a lot of lobbying against what they are doing. And I think appreciating the power of lobbying companies, they are very powerful. Maybe the timeline for Techno-verse is a bit quicker even than eight years, because you've also seen how fast Bitcoin and now also a lot of other financial services are evolving at this moment."

Big Brother

- External Market

  Attention between the financial institutions and BigTech, probably in favour of the traditional industries instead of BigTech.

  A complete ban of private blockchain initiatives might be a bit harsh.

  Financial stability not at risk probably. A lot of smart people that are working with the central banks have very smart regulations in place and monetary policies to prevent an economical disaster from happening. But their feet are tied with an anchor because of the old systems (quantitative easing, quantitative tightening), but with this new system, they are open and have all the options they can think of, complete freedom.

- Internal Business Strategy

  The role of small companies (here they are bought by the financial institutions).

- Product/ Service/ System

  Enforcement of legal framework, but it demands a lot of knowledge that is not naturally in the hands of public organizations.

  Maybe add an international system

  People will slowly move to illegal markets if the CBDC goes through. Surpassing the restrictions with "fake" transactions. People are gonna find ways to take the money that they have legally to a second economy.

- Technology

  The public agencies are starting with pilots. That's not a technological thing, but rather into Product/ Service/ System.

  Describe the public/ private BC initiatives better, they can now be confused with BC architectures.

- Resources

  Formulate knowledge hiding different.

Second Question
For this question, "Are the allocated time intervals in the pathways realistic from your perspective?", a list with comments is presented. This created an overview per column on what has to change in the pathway regarding the allocated time intervals. First starting with the Techno-verse and thereafter Big brother.

Techno-verse

- Internal Business Strategy

  Cutting loose from fiat will not be so short-term, year 8 or 10.

- Technology

  p2p financial products and services are being introduced in year three is already going on. So, either move to year one or make it a large-scale P2P introduction.

One respondent found this question quite hard: *"I say put a lot in year 3. if you have year 6 and 10. That might be better because the problem with year 8 is, it's far away"*. However, this comment is not shared with another participant, which also mentioned something regarding this point: *"I would not create another year Column"*.

Big Brother

- External Market

  I think year 3 is the first signs of regulation and in year 5 the whole world moves.

  You might separate financial issues from the other issues using regulations and that might be in year three.

  Maybe not completely obsolete private blockchain in year 3 already.

In the next paragraph, these comments on the pathways are processed and adjustments are made accordingly.

5.3.4 Adjusted Pathways

Based on the comments that are taken into account for the pathways, the pathways have changed. As presented in Figures 35 and 36

Techno-verse	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties	As there are no large-scale and widely accepted private blockchain initiatives for the payments industry, BigTech sees opportunities to extend their portfolio of (financial) products and services	Lobbying of BigTech starts on a large and global scale in order to keep the issues digital currencies Countries are profiling themselves as favorable business climate to host a large payment system	BigTech organizations have increasingly more political power due to their reach to the public, **also BigTech get more trusted, the currency from BigTech will be more trusted than the Euro or US Dollar.** Legal frameworks are kept unclear and bent to the will of BigTech organizations. **BigTech tries to circumvent regulation.**	BigTech rules
Internal Business Strategy	Financial institutions see opportunities to collaborate with BigTech organizations (opportunistic strategy) **Financial institutions will be holding up on to their market privileges.**	Numerous private large-scale bigTech-issued currencies (winner-takes it all strategy) The BigTech are making the entry of barrier for users as low as possible Cutting loose from fiat (removed)	BigTech organizations are specializing in certain areas to establish dominance there. However, their collaboration with each other result in complete dominance in the payments industry (oligopolic strategy) Financial institutions are either leaving the payment industry or will be taken over by BigTech organizations	Financial institutions are no longer active in operational activities for the payment industry, other financial products and services are the focus. **Fiat currencies will be less dependent on and less trusted.**
Product/ Service/ System	Various pilots and experiments privately initiated blockchain initiatives for the payments industry **The public agencies are starting with pilots and hinting towards planned CBDC release (taken from technology layer)**	Various networks of blockchain based application are guided by participating financial institutions Design requirement of further developments are in line with private values	The payment system is governed by a few BigTech organizations, yet, governance is still a big challenge for blockchains. Switching costs for users are high, leading to constant high network externalities **Digitalization of physical assets, making them easier transferable and more portable, resulting in new products and services (taken from technology layer)**	Various large-scale blockchain based global payment application that form the new backbone of the payment industry Develop a system with private values in mind
Technology	Various different privately initiated blockchain projects are being presented	Large adoption of innovative P2P financial products and services. Introduction of new blockchain based products and services, e.g, metaverse platforms	Mining of users is being utilized for the systems of BigTech organizations, as the need of more storage and computational power is increasing **Interoperability not across all platforms**	Develop a technology with private values in mind Even with the interoperability, the systems are in essence isolated to their respective BigTech organization
Resource	Allocated teams will assist BigTech in building a proper financial product and supporting services. **There is a shortage of expert personnel and rising demand for knowledge**	Massive amount of human and monetary resources are being spend in development and marketing in order to grow the network of users **(critical mass)**	Massive amount of human and monetary resources are being spend in development of the relative new products and services, e.g. metaverse (for the financial institutions left in the payments industry)	The traditional banks are forced to become more ICT-oriented to keep with the developments of BigTech. They are no longer at the center of the payments industry.

Figure 35: Pathway - Techno-verse - adjusted

Big Brother	Year 1	Year 3	Year 8	Vision
External Market/ Uncertainties	Politicians are trying to regulate the current private blockchain initatives for the payments industry Due to more negative-oriented blockchain related events, the public and media presses the need to regulation	**Regulation is being created that that makes privately blockchain initiatives hard to diffuse and highly regulated for the payments industry**	Financial stability is at risk due to unforeseen consequences of the national payment system. **However, these risk can be dealt with by new monetary tools and economic policies** There is a complex and detailed framework **Regulation is active that is regulating every privately initiated blockchain application**	Government is ruling
Internal Business Strategy	Working in consortiums, private and public in order to not miss any opportunities (Hesitant strategy)	Numerous public-private partnership (oligopolistic strategy) **Small companies (new entrants) are bought by the financial institutions** Current customers of financial institutions can easily switch to a digital CBDC wallet (utilization of network externalities)	Let the government become a shareholder of the financial institutions (survival strategy) Mandate (partly) state-ownership of the government for participating financial institutions **Utilization of knowledge of that is actually not naturally in the hands of public organizations**	The strategy of surviving financial institutions is purely focused on pleasing their only client, the government with their national payment system
Product/ Service/ System	Various pilots and experiments of publicly and privately initiated blockchain initiatives for the payments industry **The public agencies are starting with pilots and hinting towards planned CBDC release (taken from technology layer)**	Create one network of participating financial institutions Design requirement of further developments are in line with public values **International transactions can be possible with the new payment system**	Centrally governed system Backdoors are created for the government Enforcement of legal framework is not manageable **People are going to find ways to take the money that they have legally to a second economy**	one large-scale blockchain based national payment system Develop a system with public values in mind
Technology	Various different privately initiated blockchain projects are being presented	Maintain and increase high troughput system for state-offered CBDC Digital wallets for citizens	Monitoring of transactions Society picks up the national payment system, large amounts of data need to be stored and processed Digitalization of physical assets, making them easier transferable and more portable	Maintaining and developing the technological advancements with public values in mind
Resource	**Knowledge is not actively shared across blockchain developments** Monetary resources are being kept limited, as the business gains are still unclear	Share the compounded knowledge in the public-private collaborations Becoming a public partner will create oligopolistic incentives to invest in the CBDC development	Subsidies of the government will be allocated to the remaining financial institutions that have been (partly) nationalized There is dedicated departments at financial institutions for maintaining and development of the national payment system	The traditional banks are still the gatekeepers of financial markets. However, they now serve the national payments system.

Figure 36: Pathway - Big Brother - adjusted

5.4 Flex Points

With the constructed pathways based on the developed scenarios, identification of the flex points can start. This step is the final step in gathering information for developing the multi-scenario roadmap, as presented in Figure 37.

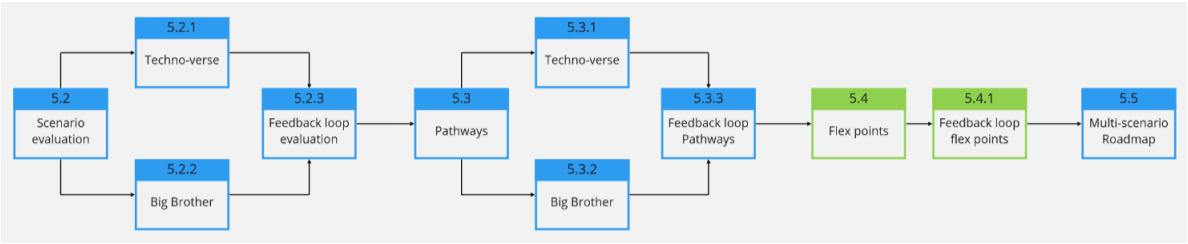

Figure 37: Roadmapping steps - flex points

Flex points are key potential developments in the environment of the study. These potential developments could have a significant impact on the evolution of technology. These flex points signal transition points of radical change, potentially leading to a shift between the trajectories in the pathways (Hussain et al., 2017). During the identification of the flex points, the following question is essential to keep in mind: "what would need to happen for each scenario to take place?" (Hussain et al., 2017, p. 170). These flex points can be externally imposed on the system or come from within the system.

The most uncertain driving factors from the scenario workshop can be considered as some sort of flex point. As the uncertainty is not about whether there will be an impact, but about what that impact may be (Cairns & Wright, 2017). So, an uncertain driving factor can be a pivotal factor. If the impact of this pivotal factor can also significantly impact the evolution of blockchain, then that pivotal factor is considered a flex point. If a driving factor has a low impact score, there is no need to map it as a flex point as the impact on the future is not significant. With this analysis, the voting session from the scenario planning can be used to derive factors that have high uncertainty and high impact. The top 5 voting regarding impact and uncertainty are listed below.

Top 5 impact voting
6 votes - Governance
5 votes - Regulation
4 votes - Vague accountability, No interoperability
3 votes - Programmable accounts (smart contracts), portability of assets
Note: the driving factors with less votes are not worth mentioning.

Top 5 uncertainty voting
6 votes - Regulation
4 votes - Governance, Vague accountability, Portability of assets
2 votes - Programmable accounts (smart contracts), No interoperability
Note: the driving factors that are not mentioned in the impact voting are not worth mentioning.

The listed factors can be considered as potential flex points. As governance and regulation are already used in the development frame, they already create the environment for the scenario and subsequent pathways. Meaning that within the development frame of governance and regulation, there are numerous other future outlooks within this spectrum. In this research project the two outliers, the two most extreme combinations have been sketched, they are already the boundaries within which pivoting is possible. Nevertheless, a specific form of regulation or governance can be incorporated as flex points. Specific regulation that is purely focused on market allowance of blockchain, the form of which blockchain applications can participate in the payments industry. This specific regulation can be considered as a flex point, as it disruptively shapes which types of blockchain initiatives will shape the payments industry, for example completely regulated blockchain applications, anonymous blockchain applications, and systems, or complete freedom in the allowed blockchain applications. This aspect of regulation can have detrimental consequences to the blockchain development direction, as presented in Ozili (2019) and Zetzsche

et al. (2020).

Back to focusing on the top 5 voting regarding impact and uncertainty. Accountability and interoperability have sufficient votes for impact to be considered as flex point, as can be seen in the list of top 5 impact voting. Programmable accounts and portability of assets have a low amount of votes on impact, thus not considered flex points. These driving factors result in a low impact on the future that will not result in a significant shift of paths. They might have a higher uncertainty than interoperability, however, their impact on the future is lower, making them not a flex point. For example in the case of portability of assets, with a low voting count on impact but a high count uncertainty. The high uncertainty might result in innovations or changes in the development of blockchain applications, but with the low perceived impact, these changes will not result in pivotal changes in the strategic path of financial institutions. Leaving two flex points based on the top 5 voting on impact and uncertainty, namely, accountability and interoperability.

One flex point that is not covered in the driving factors is funding. Funding is mentioned as a flex point in the use case of the chosen scenario-based roadmapping literature Hussain et al. (2017). Funding can have an impact on technological developments, as organizations or other entities such as a government will need to dedicate monetary resources to their favourable blockchain initiatives, for them to start and grow to guide future developments in their favour. Thus, funding can create a pivotal situation in some scenarios. As this factor is not presented in the literature review and voting, further validation for this research project is necessary for funding. The list of flex points is presented in Table 19.

Flex Point	Uncertainty	Time period (years)
Regulation	Completely regulated, anonymous blockchain applications and systems, or complete freedom	0 - 10
Funding	Subsidized blockchain endeavours or privately invested blockchain initiatives	0 - 5
Interoperability	blockchain systems that are working coherently with each other or separate systems	5 - 10
Accountability	Consumer protection in favour for the government, BigTech or users	5 - 10

Table 19: Flex points for the roadmap

Up until now, only the flex points themselves are described. Nevertheless, flex points can only be impactful or uncertain for a certain period. First to provide some more clarification of the chosen flex points in Table 19, certain examples of uncertainties are provided to shape the possible pivotal shifts regarding each flex point. Thereafter, a period is allocated to each flex point.

Regulation can be sluggish and develop significantly over time, meaning a long period is necessary to dedicate, 0 - 10 years are picked for this. The necessary foundation of legal frameworks is currently being introduced, within a decade this will continue to bend to a certain direction from a scenario, e.g. completely regulated, anonymous, or complete freedom as outlier examples. Funding can have a great impact at the start, thus 0 - 5 years are allocated, with the examples of private and public investments. Interoperability and accountability are flex points that can have an impact on a later period, as during the start their impact is not that high. Interoperability will be important when a few large initiatives have grown and survived the starting years, as is the case for accountability. Hence, a period of 5 - 10 years is expected to have a potential pivotal effect. The same essence as for the pathways are used in this exercise, the years are not probabilistic predictions but just mere fluid time windows, also the reason why they are in steps of 5 years, as also has been done in the scenario-based roadmapping literature Hussain et al. (2017).

5.4.1 Feedback Loop - Flex Points

The last feedback loop regarding roadmapping is for the flex points and any other comments regarding the entire interview. Three questions are asked in this last phase of interviewing. After introducing the flex points, "Do you agree with these flex points? What should be changed or is something missing?", "Are the allocated time periods of the flex points realistic from your perspective?", and "Do you have other

remarks that you would like to share or address?". Summarized responses per question, per respondent, can be found in appendix C.3.3.

For the last question, "Do you have other remarks that you would like to share or address?", two responses are noteworthy to present in this thesis. The first response has an impact on the results of the flex points and the other response is a memorable closing remark that is shared at the end of this paragraph. A respondent utilized the moment to think of one more aspect to address in the roadmapping exercise, as described below:

"Countries are actually able to close down Infrastructures, closing down the Internet. So, we haven't really looked into this Political systems. That could also be a Turning point – if countries turn their back towards a scenario. However, currencies in the libertarian scenario, could actually take out the influence of geopolitics. If the digital one is just flowing through platforms and privates, it will be far harder to shut it down."

Some feedback regarding the flex points lead to adjustments, as presented in Table 20. First of all, the stand-alone name "regulation" for the first flex point created some confusion for some participants. This confusion came forward from the fact that regulation encompasses some other flex points such as interoperability and accountability, but also confusion as regulation is used as a driving factor in the development framework for the scenarios. Thus, based on a comment from one of the respondents, the name "regulation" is better described by the name "market regulation". Second, funding is by most not recognized as significantly important, however, market development and first-mover initiators are recognized as important factors. Funding is a part of this bigger force of market leaders. Important and uncertain enough that it causes a shift during the start of the roadmap. Hence, funding is replaced by market leaders. This new flex point also incorporates the current cryptocurrency environment, will it completely break down or become a standard practice for doing transactions in the future.

Furthermore, new flex points are derived from the comments of the respondents, cyber security, and efficiency. Cyber security is related to the chances of more hacking approaches and uncertainties regarding new forms of cyber compromises. As also recognized in the literature, cyber security risks "that we don't even can think off", but also the (sudden) rise of quantum computing can compromise the security of the entire blockchain-based network. Efficiency relates to a sudden discovery of a highly efficient blockchain-based mechanism. The respondent expects that this can shift the developments towards the Techno-verse scenario, as BigTech organizations will probably adopt these efficiency gains, leading to more adoption by the public and power for the BigTech organizations. One mentioned potential flex point regarding political systems is not taken into account in this adjusted list of flex points, as the complexities and uncertainties surrounding those aspects are too complex to incorporate. It is much bigger than all the other flex points and deserves its dedicated research project in future research.

Regarding the periods for the flex points, most respondents generally agreed with the allocated periods. For regulation, 0 - 10 years makes sense to most respondents, however, there are some comments that it could be longer, e.g. maybe 15 years, and one responded even mentioned that it could start later, starting 1 or 2 years. As the steps are 5 years, the longer duration can be adjusted, however, the starting point can remain the same. The shift to longer periods is also recognized by the respondents for interoperability and accountability, especially for accountability. However, there is quite some hesitance in how much more there should be added. There are more comments towards accountability, thus that one is extended. Respondents had no strong opinions regarding the shift in the period of interoperability. The starting point of 5 years is recognized by most respondents, only one respondent commented that 5 years seems a bit late, perhaps three years is a better fit. Given the argument of steps of 5 years, the starting point of 5 years for interoperability can stay. For funding, which is now market leaders, 0 - 5 makes sense, as this can have an impact at the starting years of the roadmap.

For the new flex points, cyber security got a starting period of 10 years from the respondent who suggested it. Given the large uncertainty, no ending time is allocated to this point. Efficiency has an early time frame, as people will be locked-in once people are in a system with high switching costs. Meaning that there will not be much impact on a later time frame.

Flex Point	Uncertainty	Time period (years)
Market Regulation	Completely regulated, complete freedom, or anonymous blockchain applications and systems	0 - 15
Market Leaders	Who will lead the market, public or private blockchain initiatives.	0 - 5
Interoperability	blockchain systems that are working coherently with each other or separate systems	5 - 10
Accountability	Consumer protection in favour for the government, BigTech or users	5 - 15
New flex points		
Cyber Security	New forms of cyber security threats, e.g. quantum computing or leveraging other vulnerabilities	10 - ∞
Efficiency	More efficient blockchain based mechanism that drastically change the need for computational power, energy requirements, and throughput time	0 - 5

Table 20: Adjusted Flex points for the roadmap

5.4.2 Closing Remarks Interviews

One respondent closed the interview very memorable and also in-line with the essence of this research project, as described below:

"Again we see technological development invites us to really think about how we want to organize things, the aims. I like to reassess, re-think how we want to organize society. If there is not a necessity to do that, as blockchain does, we just go on as we always did. Never waste a good crisis, technological development – things are suddenly undermined. Things that really fundamentally ask us to rethink, what do we want to achieve?"
"You ask the right questions."

5.5 Multi-scenario roadmap

Up to this point, all the required data regarding roadmapping is collection, analysed and adjusted based on interviews. Meaning that this paragraph is focusing on the final research activity of this research project, the development of the multi-scenario roadmap, as visualized in Figure 38.

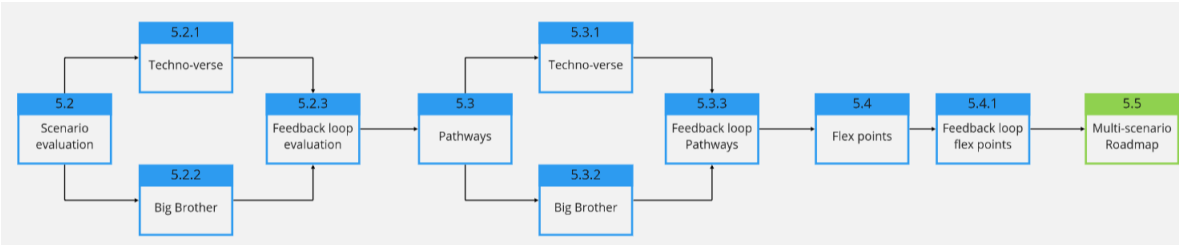

Figure 38: Roadmapping steps - multi-scenario roadmap

With this data of the most plausible scenario, pathways (External market, internal business strategy, product/ service/ system, technology, resource), and flex points, a multi-scenario roadmap can be created by following Strauss & Radnor (2004). The roadmap starts with a central or chosen scenario in mind, in this case, the Big Brother scenario. Big brother is used for starting the directional path of the roadmap, this scenario is considered the most plausible scenario.

First of all, there is a time element in a roadmap. This time frame is linked to the pathways and flex points, given that one flex point is too far to take into account, it is not taken in the visualization. This flex point is cyber security, it starts from 10 years. Thus, well over the scoped time frame of the 2030 horizon. The activities and their sequence can be based on the constructed pathways, especially based on the product/ service/ system and technology columns as those resemble descriptions that can be translated to activities without much ambiguity. Nevertheless, these activities are derived from the

strategic direction, resulting in a roadmap with strategic paths. The activities are visualized with nodes and the lines reflect which scenario essence the tasks are guided. Furthermore, there are some key decision points in the roadmap visualized with diamond shape icons. These key decisions resemble a potential shift to another scenario and are often linked to major investments (Strauss & Radnor, 2004). The multi-scenario roadmap is presented in Figure 39.

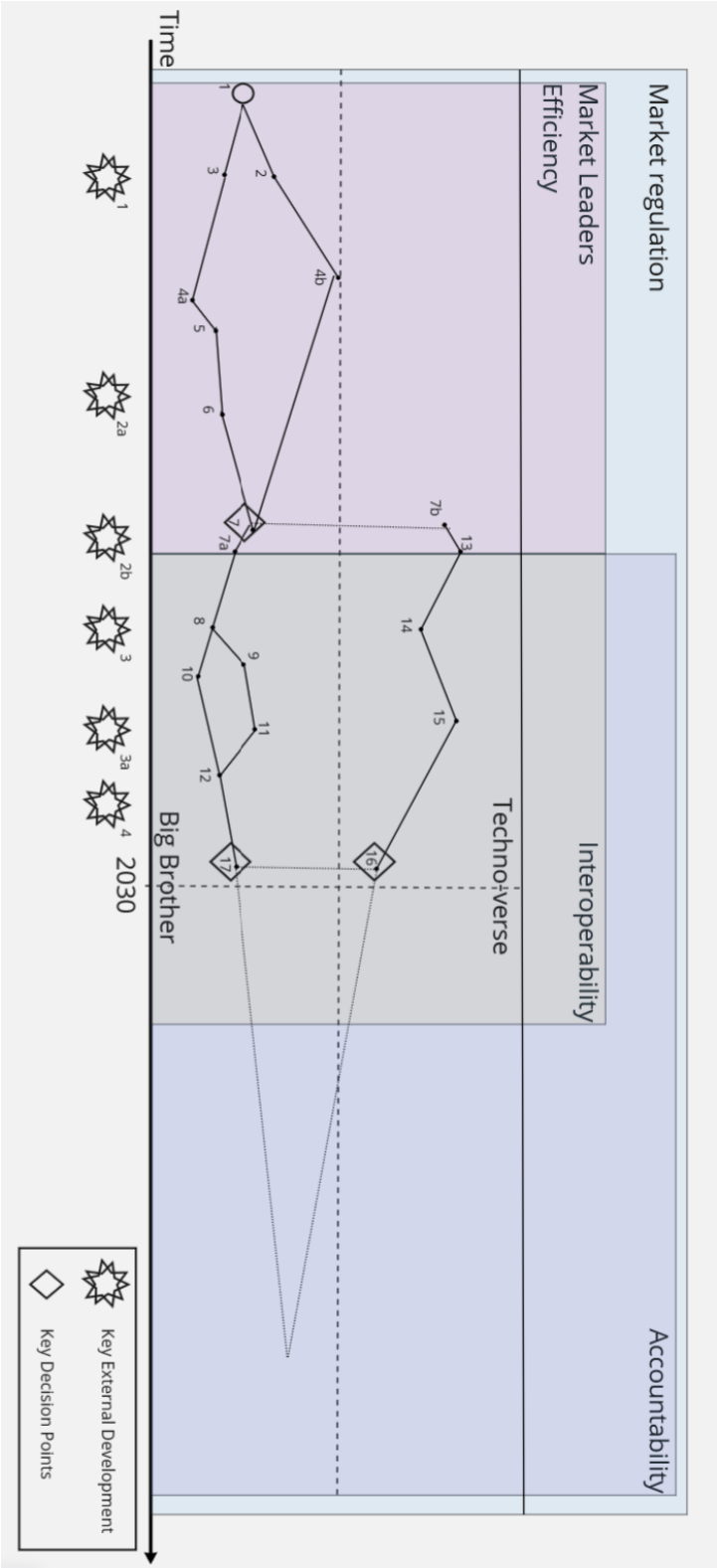

Figure 39: Multi-scenario roadmap

Activities in the multi-scenario roadmap

- 1 - Starting point with hints towards publicly initiated blockchain applications
- 2 - Private initiatives are pursued
- 3 - Public initiatives are pursued
- 4a - Financial institutions join collaborative partnerships with public agencies
- 4b - Financial institutions are involved in collaborative networks with BigTech
- 5 - Financial institutions are assisting in designing and developing the blockchain-based payments system for the government
- 6 - Digital wallets for citizens
- 7 - Choice for the financial institutions where to focus their knowledge and resources, driven by new (upcoming) market regulation
- 7a - Equity hand into government
- 7b - Financial institutions are choosing for BigTech partnerships
- 8 - Government asks for backdoors in the financial institutions' activities and responsibilities
- 9 - Financial institutions utilize their technical knowledge for the national blockchain-based payment system.
- 10 - Subsidies determine the areas of development for the national payment system
- 11 - Financial institutions assist in the enforcement of the complex and detailed legal framework by leveraging their legal knowledge
- 12 - Financial institutions are still the gatekeeper, but now for the national payment system
- 13 - Surviving private partnerships will continue private blockchain developments
- 14 - Large-scale P2P financial products that are in the grey area of legislation
- 15 - New blockchain-based products and services, e.g. metaverse
- 16 - BigTech can facilitate second economies
- 17 - Government rules

Key external developments

- 1 - Private initiated blockchain results negative-oriented events, push for regulation
- 2a - Lobbying will keep the door open for BigTech initiatives during the construction of market regulation
- 2b - The outlook is that it will be hard to be become dominant with private blockchain initiatives in the payments landscape due to upcoming market regulation
- 3 - Complex and detailed framework is released
- 3a - BigTech circumvents legal framework with products and services in the grey areas
- 4 - Second economies are emerging, which can be facilitated by BigTech initiatives

The Y-axis in the multi-scenario roadmap represents the directional step of each activity in the roadmap. As determined in the feedback loop of the scenario evaluation, the starting point for blockchain development must be in the Big Brother area. Hence, if an activity is going up, it means that such a task is moving towards the extreme of the techno-verse, when going down, the activity is more linked to the Big Brother environment.

Financial institutions need to define checkpoints based on this multi-scenario roadmap, continuing with validating the assumptions that have been made, signaling external developments and scenario descriptors, and monitoring their current progress. Based on these activities, GO/No-Go decisions can be made at certain periods in the roadmap, for example during the key decision points, diamonds icons in Figure 39. Decisions must be based on volatility, e.g. the signaling of a flex point development or (sudden) external developments that might be in line with a scenario descriptor. As can be seen in the roadmap, market regulation and interoperability (second economies shift) have a potential pivotal impact on the roadmap. Other flex points should be signaled, analyzed, and mapped such as done for market regulation and interoperability. For example, the flex point efficiency can create a bridge between 4b and 7b as well, however, this must be a somewhat disruptive efficiency gain, as, during that time interval, regulation starts to kick in place.

The pivotal shifts in the pathways can occur and lead to strategy changes. Given the high uncertainty surrounding flex points, there is no telling the degree they affect the strategy and necessary activities. There may occur modestly affected change in the path, a "flex", but the start of a "fork" might also be arising, a full-fledged shift to the strategy. Hence, the previously described tasks that are needed from financial institutions are of significant importance.

What is taken into account when developing this roadmap are the comments of a few interview respondents regarding that the paths might end up in the middle. As one respondent noted: "there is already an aim towards to big brother, but it seems that BigTech has large power, so slowly shift to techno-verse and end up in the middle. Where sure we have CBDC, but we also have to some extent freedom of these cryptocurrency companies". Lastly, as Strauss & Radnor (2004) noted, financial institutions need to continually refine these scenarios as these future outlooks come closer to reality and adjust the multi-scenario roadmap for their favourable paths accordingly. It is advised by the reviewed literature to repeat these scenario planning and roadmapping activities, especially given the intensity of changes that are present in blockchain development.

5.6 Concluding Remarks Chapter Five

With the developed scenario narratives, a strategic plan is developed for financial institutions to reach them or a combination between them. An evaluation of the developed scenarios is conducted on various levels, such as government, industry, corporate, and society. Based on this evaluation, data that contributed to developing the scenarios, and reviewed literature, the necessary strategic steps to reach a scenario are derived and merged into pathways. These were mapped in an architectural framework, called a technology roadmap, also called a pathway. Once the pathways are constructed, flex points were identified to check if shifts in the roadmap could happen. Given the highly uncertain world of blockchain in finance, there are quite some flex points discovered. These flex points are visualized as the strategic blockchain development options of financial institutions in a multi-scenario roadmap. The scenario evaluation, pathway construction, and flex point identification are supported with feedback loops based on interviews. This data collection and subsequent analysis resulted in some necessary adjustments in some roadmapping aspects, such as changes in the pathways and more identified flex points.

Sub research question 4 (SRQ4), "Which strategic pathways prepare financial institutions in the payments industry to address blockchain development?", is answered in this chapter by presenting a multi-scenario roadmap, see Figure 39. This roadmap encompasses the possible paths that can be taken in the field of blockchain for financial institutions. These paths prepare the financial institutions for what their options are within these environments and allow them to recognize (external) developments that might shift the blockchain space in the payments industry.

The next chapter condenses all the results from current research endeavors into an answer to the main research question. This last chapter concludes the research project.

6 Conclusion

This last chapter of the thesis is focused on answering the main research question (MRQ), "Which strategies are available to remain competitive in the blockchain-based future?". In order to answer this question, results from all the sub research question need to be derived and combined into one answer. This synthesis happened in this chapter. First, the conclusions are discussed from the sub research questions and formulated into an answer for the MRQ. Second, limitations, future research, and a reflection on the MoT master program are presented.

6.1 Conclusions

Based on an introductory investigation of the current status quo regarding blockchain in the financial sector, various knowledge gaps are synthesized which this research project anticipated. This research project focused on the following gaps: identifying which financial applications should be developed first, proposing directions for future blockchain development, and contributing to the lack of empirical evidence on real-world implications. Furthermore, various arguments were proposed regarding the focus on the payments industry and financial institutions, for example, the vast blockchain developments in the payments industry, the natural application of blockchain to financial institutions, the payments industry with the first real-world implementations of blockchain within the financial sector, and the likely-hood for payments to become a front-runner in large-scale diffusion of blockchain.

These knowledge gaps and scope translate to the research objective, *"building future outlooks of blockchain in the payments industry and developing a strategic planning for financial institutions"*. Research questions are defined for obtaining the necessary knowledge to reach this objective. One main question is formulated and subsequent sub research questions (SRQs) are developed to break down the main research question into comprehensible parts, guided by scenario planning and strategic planning.

The **main research question** which is answered in this research project is; *Which strategies are available to remain competitive in the blockchain-based future?*

The developed future outlooks show possible images of where developments could head in terms of a blockchain-based future. Strategic planning identifies possible paths toward those possible images. Financial institutions can use these outlooks and pathways in their favour by steering their strategy towards external developments regarding blockchain in the payments industry. Hence, answering the main research question creates insights by which financial institutions can develop their blockchain endeavors and allow them to remain competitive in a blockchain-based future. To answer this question and reach the objective of this research project the sub research questions provided the necessary information. This information is synthesized to answer the main research question and show that the research objective is reached.

Sub Research Question 1
First of all, the future needs to be determined before development paths can be defined. Given the high amount of uncertainty related to blockchain, scenario planning is a suitable methodology to create snapshots of the future (future outlooks). To utilize this broad methodology, a specific research method is necessary to choose, preferably qualitative based, able to deal with high uncertainty and with a connection to strategic planning. Answering the first sub research question (SRQ1), "What is a suitable methodology of scenario planning that can develop qualitative blockchain scenarios for the financial sector in the payments industry?", provided a fundamental basis for the research project. This resulted in the usage of a scenario-based roadmapping method by Hussain et al. (2017), which in turn is backed by the book "Scenario Thinking" from Cairns & Wright (2017) and the roadmapping approach of Strauss & Radnor (2004).

The qualitative activities of this research method translate to workshop and interview activities to collect data from participants. The workshop deals with scenario development in phase one and interviews are utilized for the second phase of roadmapping. After setting the scene in terms of horizon and scope, (key) driving factors were derived from reviewed literature. These driving factors are covered in the next sub research question.

Sub Research Question 2
With a chosen research method and described research design, the steps to answer the main research

question were formed and used as the backbone in further research activities. The basis for the scenario development workshop is determining the driving factors of blockchain developments in the payments industry, also considered contextual variables. This research activity is condensed in sub research question 2 (SRQ2), "What are the contextual variables that impact the current state and future of blockchain in the payments industry?".

The contextual variables are derived from an extensive but comprehensive literature review. The literature review is extensive in the sense that 18 papers have been reviewed and synthesized in this chapter. However, due to the categorization groups of opportunistic and challenging, and thematic allocation based on the PESTLE framework, the large amount of information can be viewed in a comprehensible manner, as presented in Table 21. In total, 33 contextual variables are derived from the literature review and are used to answer the second sub research question. The contextual variables are shaping the boundaries in which the future outlooks can be developed as they form the foundation of the scenario development process. The contextual variables are used to derive the most impactful and uncertain factors, those are the core of the future outlooks. In the sub research question, the future outlooks are presented in the form of scenario narratives.

Domains	Opportunistic Driving Factors	Challenging Driving Factors
Political	CBDC	Decentralization and self-governance risks Regulator perception
Economic	Cost reduction Solve double spending Economic dependency	Economic impact Risk in early adoption Business uncertainties
Social	Fear of missing out (hype) Competitive environment Corporate Social Responsibility (CSR)	Public perception Financial privacy Consumer protection Culture changes Lack of terminology
Technological	High Security Tunable privacy Bottom-up technology push (Fintech) Quality improvement	Scalability Interoperability Cyber security Data related concerns Flaws in control mechanism Technology dependency
Legal	Leveraging IP	Enforcement Liability and accountability Jurisdictional
Environmental	Low waste potential (efficient)	Storage and computational needs (Energy)

Table 21: Contextual variables of blockchain in the payments industry

Sub Research Question 3
Sub research question 3 (SRQ3), "What are possible scenarios of blockchain for the payments industry?", represents the first activities of qualitative data collection from participants. A scenario development workshop was designed to develop scenarios. The workshop follows the steps; setting the scene, impactful driving factors, uncertainties, scenario framing, and scenario development. Thereafter, scenario narratives are developed to provide a coherent and overarching story regarding a future outlook. The workshop was built with the foundation of the contextual variables from sub research question 2.

SRQ3 is answered by presenting two scenario narratives, namely, **Techno-verse** and **Big Brother**. Each scenario is based on a scenario frame constructed with two extreme situations of the most impactful and uncertain driving factors. The driving factors are governance and regulation, each with two extremes, law of the jungle versus state incentives CBDC and libertarian versus strict/ detailed/ comprehensive regulation, respectively. Scenario **Techno-verse** represents a combination of "law of the Jungle" and "Libertarian". It is driven by BigTech dominance and the digital/ technology entities that are ruling.

Given that Blockchain is everywhere, the world revolves around web3 and other blockchain applications, resulting in an ecosystem where there is no place for a traditional bank because everyone can become a bank. Scenario **Big brother** represents a combination of "State incentivized CBDC" and "Strict/ detailed/ comprehensive regulation". This scenario is driven by a national blockchain-based payment system, which is diffused country-wide and controlled by a government. This system will form the backbone of the payments system in the financial markets.

Hence, by answering SRQ3, the first part of the research objective is achieved and the first direct step towards answering the main research question is taken. The future outlooks from the perspective of financial institutions in the payments industry are sketched by the scenario narratives. These future outlooks are the guidelines for the roadmapping activities, discussed in the next sub research question.

Sub Research Question 4
The scenario narratives are used to derive the necessary information for reaching the second part of the research objective and gather the remaining data for answering the main research question. A strategic planning exercise called roadmapping is used for the last phase of research activities, guided by sub research question 4 (SRQ4), "Which strategic pathways prepare financial institutions in the payments industry to address blockchain development?".

The scenarios are evaluated, pathways are constructed for reaching the scenario narratives and flex points are identified that could result in (pivotal) shifts in the pathways. The scenario evaluation, pathway construction, and flex point identification are supported with feedback loops based on interviews. Based on this information SRQ4 is answered by the development of a multi-scenario roadmap, presented in Figure 39. The paths in this multi-scenario roadmap prepare the financial institutions for their options within these extreme environments and allow them to recognize (external) developments that might shift the blockchain space in the payments industry.

Main Research Question
To answer the main research question, *"Which strategies are available to remain competitive in the blockchain-based future?"*, the future outlooks from the perspective of financial institutions in the payments industry are sketched in the form of **Techno-verse** and **Big brother**. Strategic pathways show how blockchain can be competitively developed in the future from the perspective of financial institutions. Blockchain can be developed by tweaking the strategy of financial institutions in the realm of the possible strategic pathways and flex points that are constructed in the possible future outlooks of the techno-verse and Big Brother through a multi-scenario roadmap. In both future outlooks competition from BigTech, new entrants (Fintech) and public blockchain initiatives are forming a threat to the current financial institutions. The multi-scenario roadmap contains strategic pathways that can be used to leverage this competitive environment, resulting in available strategies to remain competitive in a blockchain-based future. This research project has a few key (novel) contributions:

Key Contributions

- Synthesis of contextual variables that impact the current state and future blockchain developments specifically for the payments industry.
- New driving factors that impact the future of blockchain in the payments industry based on the scenario development workshop.
- Extreme future outlooks of blockchain in the payment industry.
- Flex points that could detrimentally shift the field of developments in the blockchain payments space.
- Multi-scenario roadmap containing strategic paths for financial institutions within the spectrum of **Techno-verse** and **Big brother**.

To conclude, future outlooks of blockchain in the payments industry have been built with scenario planning and a strategic plan is developed in the form of a multi-scenario roadmap for financial institutions to competitively guide their blockchain developments in the future. Hence, reaching the objective of this research project. A truly novel piece of work.

6.2 Relevance

This section highlights the relevance of this research project in terms of academic, societal, and managerial relevance. The novelty aspects of this research project are discussed based on the findings and actionable items are presented for the financial institutions.

Academic Relevance
The paper of Bateh (2019) noted that blockchain is a board-level concern and provided some guidance on how to deal with this concern. First, self-educating on the technology and possibilities to encourage strategic conversations and forward-thinking. Second, strategic planning to establish necessary capital investments and implementation of blockchain within the organization. Third and lastly, grasping the (digital) skills, competencies, and capabilities needed for the senior or executive teams. The current academic field supplies enough knowledge for step one. For steps two and three, there is a serious and needed gap to fill for academia. In this research project, strategic planning for financial institutions is a focus on step two. The knowledge that is currently not properly covered in the current academic field of blockchain in the payments industry. Step three can be considered a long-term actionable item for financial institutions.

This focus on scenario-based roadmapping has a rich academic history. The field of technological forecasting and strategic planning is quite evolved (Rohrbeck et al., 2015; Gordon et al., 2020). Yet, the combination of technological forecasting, strategic planning, and blockchain in the payments industry is a gap in the reviewed literature. This research project provides guidance and directions for new academic research. Besides creating a new stream of academic literature regarding blockchain development in the payments industry, this research project also addresses another problem in the reviewed literature, the lack of empirical studies.

A successful scenario development workshop resulted in new driving factors and insightful discussions regarding the governance and regulation of blockchain in the payments industry. Examples of new factors are programmable accounts (smart contracts), portability of assets, and poor understanding of blockchain, to name a few. Furthermore, this scenario development workshop resulted in two concrete future outlooks of blockchain in the payments industry, namely, **Techno-verse** and **Big brother**. Concrete snapshots of the future outlooks of blockchain in a financial environment, a new contribution of knowledge to the existing future outlooks of blockchain in the payments industry, if there are any.

Lastly, a key contribution of this research project is the identification of flex points. These are factors that have the potential to detrimentally shift the blockchain developments in a certain period. The following flex points are identified in this research project: Market Regulation, Market Leaders, Interoperability, Accountability, Cyber Security, and Efficiency. Identification of flex points has not been encountered before in the reviewed academic field of blockchain in finance.

societal Relevance
The relevance for society relies upon the current situation of blockchain in the payments industry, many uncertainties are unclear and can impact people in a community or society as a whole. The scenarios **Techno-verse** and **Big brother** help with understanding the extreme future outlooks of blockchain in the payments industry. With the scenario analysis on a societal level, this research project in turn sheds light on how disruptive the financial situation of a society can be in a blockchain-based world. As one respondent closed an interview very memorable and also in line with the essence of this research project: *"Again we see technological development invites us to really think about how we want to organize things, the aims. I like to reassess, re-think how we want to organize society. Things that really fundamentally ask us to rethink, what do we want to achieve?"*.

Managerial Relevance
Possible future outlooks of blockchain in the payments industry for financial institutions are sketched through scenario narratives. Based on these scenario narratives, a strategic plan in the form of a multi-scenario roadmap is developed to provide a better understanding of the strategy options and necessary resources to reach possible future outlooks of blockchain somewhere in the realm of the two extreme scenario narratives. Based on the provided strategic pathways and key contributions, a list of actionable items can be constructed for financial institutions.

Short-term

- Define checkpoints based on the strategic pathways and flex points.
- Validating the assumptions that have been made in this research project.
- signaling external developments and scenario descriptors, as provided in this research project during the scenario development and roadmapping activities.
- Monitor the current progress of the market development concerning the financial institutions' blockchain development.

Long-term

- Go/No-Go decision can be made for blockchain strategy directions and resource allocation at certain periods in the multi-scenario roadmap, for example during the key decision points.
- Financial institutions can replicate the process steps from this research project to further explore how blockchain can be developed within other future outlooks. The possible paths and linked activities are not bound to what is described in this research project, as there are potentially more possible future outlooks. This is also advised by the reviewed literature, to repeat these scenario planning and roadmapping activities.
- Determine the (digital) skills, competencies, and capabilities needed for the senior or executive teams regarding blockchain development in the future and roll out this knowledge across the organization and relevant partners.

This list of actionable items provides financial institutions with handles to navigate in the fast-changing field of blockchain developments. External developments and their effects can be put in perspective based on the analysis that has been performed in this research project. Based on these activities and obtained knowledge, financial institutions are informed on how they can remain competitive in the blockchain-based future.

6.3 Limitations

This section focuses on certain choices and assumptions in the performed research activities and used methodologies. First, the research approach is discussed regarding the used literature and usage of the chosen scenario-based roadmapping method. Second, the generalizability of the study is analyzed. Second, a focus on the collaborative and participatory elements of the scenario development process. Third, the interview respondents and the roadmapping process. Lastly, key assumptions are discussed that have been used in this research project.

Research Approach
The first choice during the research approach that can be seen as a limitation is the selection of various journals and filters during the literature search on scenario planning literature. Given the evolved nature of scenario planning, no filters or selection of specific journals resulted in an incomprehensible forest of articles about scenario planning and its use cases. Thus, only journals focused on technology forecasting were selected, which can be seen as a limitation, as there might be other suitable scenario planning streams and methods that are not presented in the literature search results.

Another limitation of this research project related to the research approach is the duration. The chosen research method has an intervention of sixteen months in its use case, while this research project had an effective intervention of fewer than three months. Nevertheless, the results are still of significant value and can be used to guide future research. The duration of this research project resulted in one scenario development frame and two scenario narratives. The utilized research method indicated to create of more scenarios development frames and more scenario narratives, which in turn take more time to develop due to the various iterations in scenario development on different frames. This opportunity of more scenarios is discussed in the future research part of the conclusion.

Continuing on the matter of the chosen research method but now with a focus on the roadmapping activities. The chosen research method described that participatory workshops are preferred, as it supports the development of shared mental models, promote better connections and integration between the necessary

steps and improve the sensemaking of the entire process. However, an interview approach is used instead of another workshop due to the limited time for this research project. A second workshop or another form of collaborative participatory activity was not feasible for roadmapping unfortunately. This can be seen as a limitation of this study.

Generalizability
Further limitations are the generalizability of the study, which is common for scenario planning and especially within technology roadmapping, given its normative nature. Furthermore, as presented in chapter two, Judgement sampling is used in this research project to find suitable participants, based on the scarcity of suitable participants. Meaning that subjects who are in specific positions at relevant organizations or experts in the field of blockchain in finance, especially in the payments area were sought after. Judgment sampling makes the generalizability of this study questionable, as the experts are conveniently available for this study. However, this was the only method for reaching the necessary knowledge.

Practices have been developed to achieve external validity in qualitative research. However, given the fact that this research project uses the judgement sampling practice, most practices are not suitable. Two examples of such practices are supporting generalizations by counts of events and ensuring the representativeness of cases and the inclusion of deviant cases. Counting the events will not do much as they are based on conveniently available experts and inclusion of representative and deviant cases is also not possible as there is no research found during this research project that is covering the mentioned research avenues that are addressed in this research project. More studies such as these are necessary to create the ability to further increase the generalizability of this research project.

Besides, these scientific practices regarding the generalizability, the findings of this study are in some aspects related to the reviewed literature. Hence, the findings can be generalized by the fact that they are derived from the reviewed literature and during the roadmapping also analyzed with the help of knowledge gained from the reviewed literature. These connections are the anchors in the academic field of research and help to provide some internal and external validity.

Participants and Scenario Development Process
One limitation could be that the participants from the scenario workshop and respondents of the interviews might have an eurocentric perspective, which can lead to certain nuances that are more in line with eurocentric norms and values. This is derived from the analysis that most participants are settled and living in the Netherlands. Having a more international spread of participants might change the outcomes of this research to some degree. The same can be noted regarding the background of the participants, most have an academic background. More professional participants might also influence the outcomes of this research project. These types of participants were sought after during the research project, however, given their scarcity and often busy schedules, not many participated.

The environment in which the scenario workshop was hosted can be seen as a limitation as well. Given the COVID-19 measures in place during the start of the research project and international participants, the choice for the workshop environment was online. An online environment could potentially lower the shared mental models and could inhibit connections between participants. Hence, the choice of online can be a limitation. Moreover, in an online expert group, there might be participants which are more communicative and at the forefront. This can result in a situation where other participants act more in the background. Luckily, every participant in the scenario development process got a chance to speak. Nevertheless, it can be noted that a few participants were more in the forefront.

Participants and Roadmapping Process
A limitation in the roadmapping process is the potential bias by the provision of pathways and flex points to the respondents. An option to cover this bias was to use another approach that entails that the participants come up with their pathways and flex points. Such an exercise is also conducted during the scenario development workshop but then for scenario framing. Given the usage of interviews, this option was not feasible. The option is only possible in a collaborative environment to make sure that the pathways and flex points are collaboratively in-line among the participants. This alternative roadmapping approach could result in differences in the constructed strategic pathways and even different or extra flex points.

Furthermore, during the interviewing process, participants often deviated from the question that were

being asked due to the slippery slope effect. The questions that were asked, are quite broad and cover large pieces of information. For example the question regarding the scenario evaluation and strategic pathways. Respondents were asked to answer the questions regarding specific aspects, yet, during the conversation, some respondents drifted off from answering the question. During the interviews, respondents were asked follow-up questions or asked to refocus on the asked question if their responses were drifting off.

Assumptions
This section focuses on the assumption that has been made during the research project. First, a key assumption regarding the future strategies of the financial institutions. Second, the assumptions in the literature regarding the driving factors. Third, is the analysis of scenario descriptors that lead to the scenario narratives. Fourth, is the impact on society in the scenario analysis for roadmapping. Lastly, the direction (Y-axis) of activities in the multi-scenario roadmap. These assumptions influence the outcomes of this research project and can be considered as limitations as well.

The first assumption in this research project is that financial institutions will remain in the payments industry if blockchain becomes the new standard in payments. There is a chance that (some) financial institutions will leave the payments industry and re-allocate their focus and competencies to other financial products and services.

The second assumption is regarding the opportunistic and challenging driving factors that have been derived from the reviewed literature. The papers that have been reviewed noted various driving factors that were useful for this research project. However, some papers of these papers derived their driving factors based on a bitcoin-based blockchain system, also known as a public permissionless blockchain architecture. Some driving factors might have different weights attached to them or different meanings compared to other blockchain architectures such as a private or permissioned system. As there is no telling which type of blockchain architecture will be used in the future of the payments systems, the driving factors could have discrepancies between various types of blockchain architectures.

During the synthesis of the scenario descriptors for the development of the scenario narratives, assumptions have been made for the connections between certain scenario descriptors. These connections are synthesized in Figures 24 and 25, the arrows that are visualized between the scenario descriptors. Some of the scenario development participants were also interviewed respondents and could validate this analysis of scenario development descriptors.

Furthermore, the impact on society can be seen as assumptions as well, as there are no participants or respondents who are experts in the field of the societal impact of disruptive technological innovations. As in this case, blockchain technology application in a payments environment. Lastly, the last assumption is regarding the choices for the directions of activities (Y-axis) in the multi-scenario roadmap.

6.4 Reflections

This paragraph contains a reflection regarding the key implication and findings of this research project. First, is a reflection regarding the role of other technology developments in the scenario narratives. Second, the number of current scenarios and other potential scenarios are reflected. These reflections are proposing perspectives regarding out-of-scope aspects but are relevant to understanding to comprehending the impact of this research project.

Other Technologies
The role of other technologies is not discussed in this research project. The whole research project is driven by blockchain technology and it implications on the payments industry from the perspective of financial institutions. Nevertheless, other technologies might arise and take the potential role of blockchain in the payments industry. As also mentioned by one of the respondents, "it could also be not blockchain that is everywhere, but some other technology". This response is also shared in a paper, as Kruglova & Dolbezhkin (2018) criticized, blockchain is a technology for managing distributed ledgers; it is still in competition with developments in improved and streamlined (centralized) financial systems and with new control algorithms, another (advanced) approach to manage distributed ledgers. Hence, financial

institutions and the academic field of blockchain in finance need to take these other developments into account as well, as they could potentially limit the impact of blockchain, decrease its attractiveness or even abolish it in the worst-case scenario.

Scenarios
This research project presents two scenarios, which are sufficient for the scoped research objective. Nevertheless, there are chances to explore other scenario development frames based on other driving factors than the ones used in this research project. Yet, the follow-up question should then be, what is the amount of other necessary scenarios narratives to fully map the future? There is no direct and clear answer to this somewhat philosophical question. What can be said based on the gathered data and findings from this research project, there are a lot various driving factors that impact the future of blockchain. Yet, only a handful will probably be of great impact and uncertainty. Hence, the focus should be on the most impactful and uncertain driving factors. Furthermore, as noted in this research project, the scenarios are not for prediction but for guidance towards identifying possible tipping points or strategic pathways.

6.5 Future Research

This paragraph focuses on possible future research avenues that can be pursued based on the activities and findings of this research project. As this research project has a high academic and managerial relevance with high novelty, various research projects can be based on this research project. First, the chances of similar research with other scopes are discussed. Second, the validation of the newly found driving factors can be considered with additional empirical research. Third, more research is necessary for the most impactful and uncertain fields of blockchain, the regulatory and governance aspects. Fourth, the current scenario development and roadmapping activities can be replicated for other factors with similar high impact in uncertainty to create more snapshots of the future. Lastly, this type of research has merit for other technologies as well, future research with this exploratory degree should always be conducted for new disruptive technologies.

Other Scopes
This research project focused on blockchain for the payments industry from the perspective of financial institutions. Future research can conduct similar research in other areas of the financial sector, with scoped geographical boundaries and from other perspectives as well, such as government/ regulatory, society, or new entrants. Aspects such as specific political systems can be added to these scoped research projects, resulting in more depth and even more specific strategic pathways.

Driving Factors and More Empirical Studies
Moreover, future research can dive into the newly discovered driving factors from the scenario development workshop, as some of them are not even mentioned in the reviewed literature. Moreover, validation of the contextual factors can be conducted as well in such a study. The scenario workshop utilized experts from academia and the professional field, this results in new driving factors. Further research projects with an empirical nature are necessary for the academic literature field of blockchain in finance, as this research project provided new and fresh perspectives regarding untouched aspects of blockchain development, such as recent events in this fast-moving space of blockchain, e.g. the impact of the recent stable coin crash.

Regulatory and Governance
Future research can focus on the complexities surrounding regulatory and governance aspects of blockchain. These aspects are not often discussed in depth in the literature, usually quite superficially. Regulatory and governance aspects cover various topics, such as accountability, privacy implications, the need for interoperability, and customer protection. The need for future research regarding the regulatory and governance aspects in a blockchain environment is noted by an interview respondent. For accountability aspects, the respondent noted: "People are still very confused. Everybody is just asking questions. Nobody is providing any answers."

More Scenarios Development
Diving deeper into the scenario development process, future research can create more scenario develop-

ment frames, as previously described in the limitations. Other impactful and uncertain driving factors with similar or slight importance can still provide very useful extremes, delivering subsequent scenario narratives and alternative pathways or even more flex points. These endeavors can also address the untouched knowledge gap of potential new business opportunities when blockchain is utilized. The current literature is quite shallow on concrete examples of these new business opportunities. Future research is necessary to establish what these new financial products and services can be.

Other Disruptive Technologies
This research project can be seen as the start of a new branch of research in the academic field of blockchain in finance, probably for other industries as well. This type of research is something that needs to be replicated in other disruptive (future) high-level technologies such as blockchain. Technological factors have usually a faster development time than other domains of the PESTLE framework. For example, political and legal developments are usually much slower than technological development. Technologically, new futuristic technologies are often described by bottom-up initiators as the sky is the limit. However, this type of research asks the questions of what the sky is (scenario development), where the limits are (extreme scenario narratives), and how we can prepare for developments that signal movements directed to an unfavourable scenario.

6.6 MoT Master Program Reflection

This research project successfully completed the partial fulfillment of the requirements for the degree of Master of Science in Management of Technology (MoT). This thesis contains analytical components, is multidisciplinary in nature, focuses on a technical application or domain, shows the understanding of technology as a corporate resource, and uses scientific methods and techniques as put forward in the MoT curriculum (TUDelft, 2022; Verburg, 2022).

The requirement of containing analytical components is fulfilled as analyses are performed for the current problem fields (knowledge gaps), the variables that impact blockchain, and the evaluation of the scenarios, to name a few analytical components. Further, the multidisciplinary nature is recognized by merging multiple academic fields such as scenario planning, roadmapping, and blockchain in finance. moreover, the focus on a technical application is quite obvious, blockchain is a key element in this research project. Furthermore, Blockchain is viewed as a technology in a corporate environment throughout this entire research project by scoping financial institutions. The last requirement for the degree of Master of Science in MoT is not so clear cut, using scientific methods and techniques from the MoT curriculum. First, one course is heavily used in this research project, MOT2312 Research methods. This already contributes to this last requirement that needs to be met. Second, to show where all the connections and used techniques from the MoT curriculum come into place in this research project a detailed analysis of the MoT core curriculum courses is presented in Appendix A. It can be established that this research project meets this requirement as well, based on this analysis. To conclude, this research project successfully completed the partial fulfillment of the requirements for the degree of Master of Science in Management of Technology.

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A Appendix A Management of Technology

As described in the introductory chapter, the research project needs to be successfully completed for partial fulfilment of the requirements for the degree of Master of Science in Management of Technology. The final deliverable (thesis) must contain the following (TUDelft, 2022), (Verburg, 2022);

- The final deliverable must contain analytical components
- Is multidisciplinary in nature;
- Focuses on a technical application or domain;
- Shows the understanding of technology as a corporate resource;
- Uses scientific methods and techniques as put forward in the Management of Technology curriculum.

The requirement of containing analytical components is definitely fulfilled as the current problem field is analysed, for example a synthesis table is created for the development of blockchain in finance and the variables that impact blockchain futures will be defined in an analytical manner. The evaluation of the possible scenarios can also be considered as analytical. Further, the research project is multidisciplinary in nature, multiple fields of research are combined to perform this research. The field of technology forecasting in the form of scenario planning, the field of strategic planning in the form of roadmapping, and the field of blockchain in finance is combined in this study to add value to the current state of the art. Various types of research activities are used and combined in this research project, this can also be viewed as multidisciplinary.

Furthermore, focus on a technical application is quite obvious in this research project, blockchain is a key element in this research project. The next requirement is also fulfilled, as described in the problem definition, paragraph 1.2. Blockchain is viewed as a technology in a corporate environment, understanding that there is a need for a proper business case before corporate organizations will implement blockchain technology. This has been recognized in the reviewed literature and definitely had a role in during scenario planning and and roadmapping.

The last requirement is not so clear cut, using scientific methods and techniques as put forward in the Management of Technology curriculum. One course is heavily used in this research project, MOT2312 Research methods, as multiple times referred to the book provided in that course in chapter 2. To verify if this research project meets this requirement, an overview of the Management of Technology curriculum is necessary to pinpoint whether there is enough connection to this curriculum. The following courses are part of the Management of Technology curriculum, cohort 2020-2021,[9] see Table 22. Table 23 provides an overview of core MoT courses and their connection to this research project.

[9]This paragraph draws heavily on, and in part reproduces, material from the TU Delft study guide (Verburg, 2020).

Course	Description
MOT1412 Technology Dynamics	Understanding major characteristics of a technology and analysis of the technology from the point of view of a responsible innovation system (Innovation systems, responsible innovation, social map, values, intervention and policies).
MOT1461 Financial Management	Evaluating financial performance of companies, evaluate investment opportunities, examine financial instruments and markets, examine choices of capital structure and investments, and apply relevant techniques for evaluating risks.
MOT1524 Leadership and Technology Management	Analyze the nature of leadership management within advance technology organizations, recognize management practices and analyze the success of these, show the need for alignment between management practices and business strategy, recognize best practices regarding performance management of employees, and recognize the current and future challenges of technology firms in leading and managing people.
MOT1421 Economic Foundations	Analyze firm behavior in markets of perfect competition, monopoly, and oligopoly. Identify and appraise the rationale, scope and limits of public market regulation. Analyze and weigh up the impacts of macroeconomic policy. Understand how money is created and how the financial sector works.
MOT1442 Social and Scientific values	Values internal to science and technology are discussed in relation to the rationality of belief and action. Moral values are discussed by focusing on the ethical and social aspects and problems of technology and of professionals and managers active in the development, production and control of technology.
MOT2312 Research Methods	Creating a research design for a research problem relevant, understand core concepts of research design, and apply these core concepts to design a research project. Critically evaluate outcomes of qualitative and quantitative research, interpret statistical analysis findings, scrutinize / Reflect upon findings (i.e. validity, reliability), and suggest alternative / future research directions.
MOT1435 Technology, Strategy & Entrepreneurship	Understand the theoretical background of technology and innovation. Understand the theoretical background of entrepreneurship. Apply key technology strategy models in different sectoral and country contexts. Analyse the industry dynamics of technological innovation, companies' technology strategy. Analyse and explain the organization and structure of new product development teams.
MOT1531 Digital Business Process Management	Aligning strategy and processes. Further, Business process modeling, Business process improvement strategies, path dependencies, resource-based view, business process maturity. Furthermore, improvement methodologies, compliance by design. Moreover, business processes automation, agility and adaptability of BPM systems. Lastly, business and knowledge rules, internet of Things, and data-driven organizations
MOT1534 High-Tech Marketing	Marketing strategies and plans to deal with uncertainty in high-tech environments. First, customer segmentation, targeting, and positioning for B2B and B2C markets. Second, product and service bundles development and advertising options. Lastly, some marketing research techniques aimed at analyzing customer preferences.
MOT1452 Inter & Intra organizational Decision Making	Explain key concepts and perspectives on decision-making within networks; identify individual and collective decision biases, reconstruct and evaluate the decision process surrounding a complex real-world problem, recognize and design negotiation and framing strategies used in multi-actor decisions, and write a well-argued and evidence-based research paper on a decision concerning a wicked problem.
MOT1003 Integration Moment	Be acquainted with the MOT knowledge and skills as put forward in the first year of the program. Have a thorough understanding of the (inter-) relationships between the different parts of the MOT program and apply MOT knowledge and skills effectively.
MOT2421 Emerging and Breakthrough Technologies	Describe innovation processes on three levels: (1) project level, (2) level of the pattern of development and diffusion, and (3) discipline level. Distinguish alternative theoretical perspectives on each level. Be able to explore and analyse an innovation opportunity or problem, choose the level of analysis.
MOT2004 Master Thesis Preparation	Independently executing a literature search and literature review on a topic of choice. Furthermore, formulating a research problem, identifying a gap in the existing academic literature, relating the gap to used theories and research methods, and developing research questions based on the findings.

Table 22: Courses of the MoT curriculum with description

Course	Connection to research project
MOT1412 Technology Dynamics	A link has been made with the innovation system surrounding blockchain developments. The collaborations across the payments industry are mapped, possible values of society are taken into account in the social part of the PESTLE analysis, Environmental and responsibility aspects have been touched upon with financial inclusion, and (legal) policies surrounding blockchain development have been noted.
MOT1461 Financial Management	First of all, this course contained a guest lecture By Olivier Rikken, a good basis for understanding blockchain. Further, this course provided the knowledge to understand why blockchain has not yet a proper business case and other technologies are given a higher priority in the payments industry. It has to do with future profits and the amount of risk, the basis for understanding these aspects is gained in this course.
MOT1524 Leadership and Technology Management	Culture change is a significant organizational challenge when it comes to blockchain diffusion. This course provides the knowledge to properly assess these organizational hurdles. For example, in the literature review, most culture changes are not explicitly described as "culture change", with the knowledge from this course, an analysis of this information was possible and categorized as "culture change".
MOT1421 Economic Foundations	For only two moments in this research project, knowledge from this course was necessary to have. First, during the literature regarding economic dependency and economic aspects of blockchain effects when large-scale diffusion could happen and during the interview when a few respondents were diving into economic policies regarding a future outlook, e.g. talking about quantitative easing and tightening.
MOT1442 Social and Scientific values	This course has no strong connection to this research project. Ethics are sometimes implicitly discussed, for example during the financial exclusion or the values of society.
MOT2312 Research Methods	Especially in the first two chapters, this course knowledge has been used heavily. There is also often a reference to the book of this course in chapter two.
MOT1435 Technology, Strategy & Entrepreneurship	This course knowledge was especially useful during the roadmapping exercise. Viewing blockchain as a high-level innovation and finding strategic models for reaching the future outlooks. This knowledge also helped in analyzing the payments industry dynamics, e.g. the rise of FinTech.
MOT1531 Digital Business Process Management	Regarding the technical benefits and barriers of blockchain, this course provides a good knowledge base. For example, when discussing the implementation of blockchain in the legacy systems of the financial institutions and the disruptiveness of blockchain.
MOT1534 High-Tech Marketing	This course has almost no connection to this research project.
MOT1452 Inter & Intra organizational Decision Making	Interestingly, this course has some connection to this research project regarding individual and collective biases. For example, recognizing the individual decision bias of managers in the payments industry and collective bias regarding public perception of blockchain-based negative-oriented events. Blockchain diffusion can be viewed as a wicked problem, as requirements are changing, and making decisions is quite hard due to the high amount of uncertainties linked to the consequences and potential impact.
MOT1003 Integration Moment	Not relevant, only for planning, writing, and scheduling, this course can be considered to have a connection to this research project.
MOT2421 Emerging and Breakthrough Technologies	The same reasoning for MOT1435 Technology, Strategy & Entrepreneurship can be used for this course, as there is some overlap between the courses. However, this course has more focused on the development of an innovation. This knowledge is used for recognizing the hesitant attitude of the industry towards blockchain and judging the predictions described in the literature regarding future large-scale blockchain diffusion.
MOT2004 Master Thesis Preparation	It is clear that this course has a significant contribution to this research project. There is even a reference to the literature review of this course used in this research project, as its subject is the barriers of blockchain in finance. Knowledge gaps that are found in this research project have an origin in this literature review.

Table 23: Connection of MoT curriculum to research project

B Appendix B Workshop Scenario Development

B.1 Workshop Introduction

The workshop was hosted on April 26, 16:00 - 18:00 CEST. As any event must have, some introductory formalities were set up to welcome the participant. Further, this event was fully organized online, with participants that are not familiar with each other. Breaking the ice at the start is important to make sure that everyone is comfortable and active.

Figure 40 presents the introductory frames for the participants that are joining the Miro board. If someone joins the invite-hyperlink to the Miro board, those frames are the first view when a person is loaded into the board. Starting with thanking the participants for joining, explaining why this workshop is necessary, and what will happen during the workshop guided by planning. Furthermore, practical information is provided, such as the two-hour duration, elaborating that the first part is more individual-based and explaining that in the second part more discussion will arise due to collaborative activities. Lastly, Nadia Metoui[10] was introduced, as she was the co-facilitator and helped with managing the data input, questions from participants or miscellaneous activities.

Thereafter, the participants had the opportunity to become familiar with the Miro board in a warm-up session. This session started with a short elaboration of the functions within Miro, such as how to control the board with a mouse or touchpad, create stickies, and comment on things on the board. After the elaboration, participants could take the elaboration into practice by writing down their names.

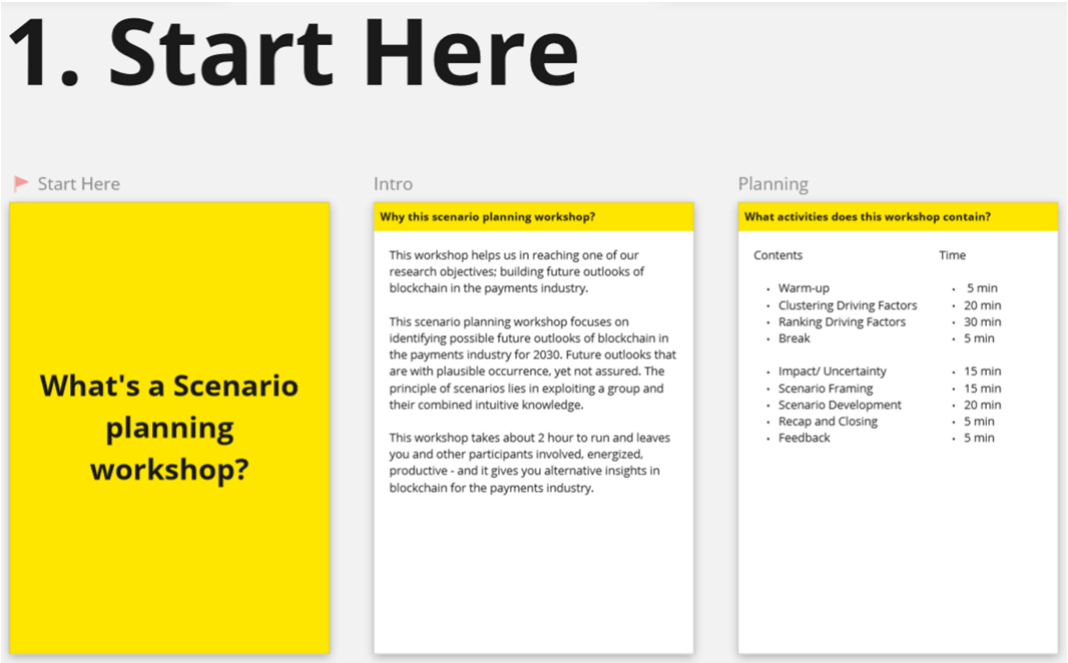


Figure 40: Introduction of the workshop

[10] Assistant Professor in Artificial Intelligence and Ethics at TU Delft, part of the Information and Communication Technology Group at the TPM Faculty.

B.2 Driving Factors Validation

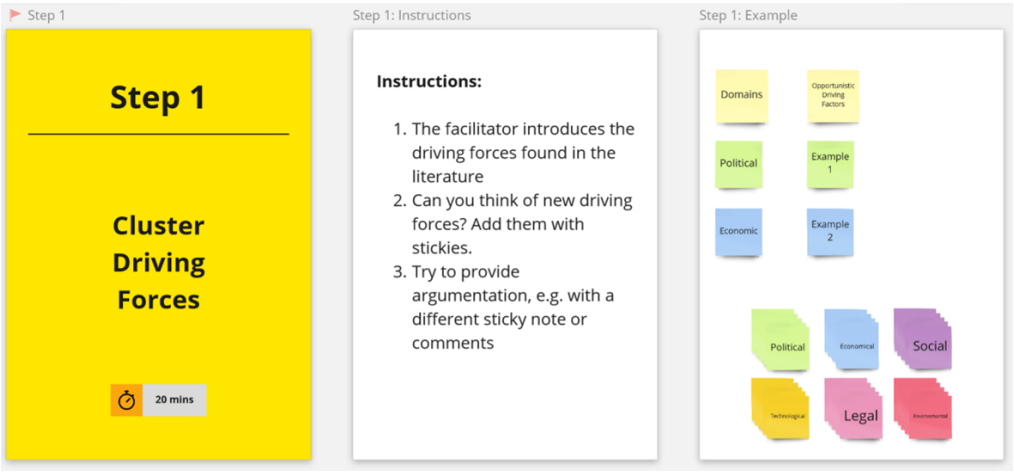


Figure 41: Step 1 introduction

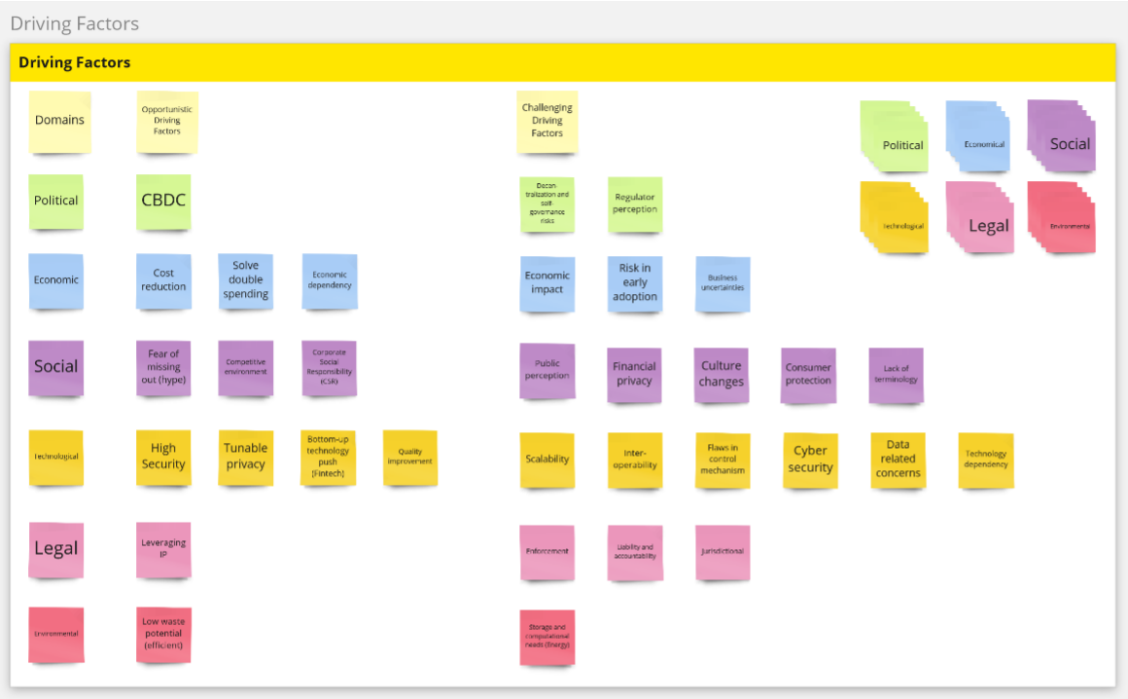
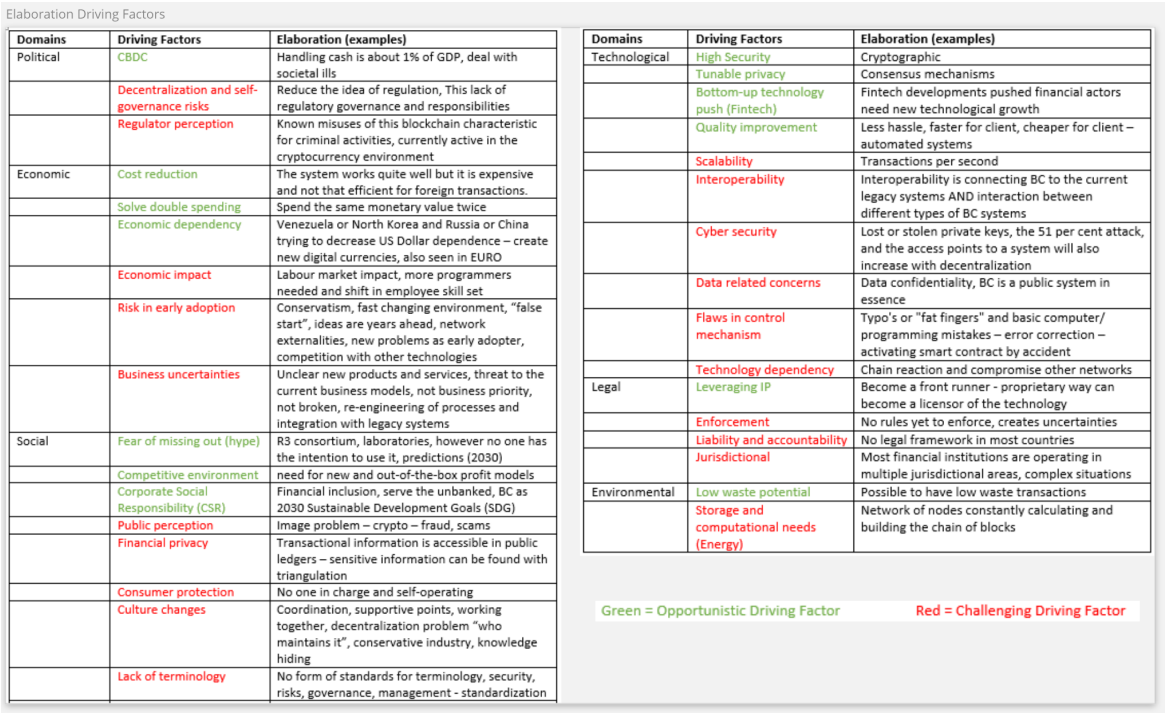


Figure 42: Step 1 Driving Factors

Now that the introduction is completed and all the participants know how to use the necessary options in the Miro environment, the data collection activities can start. The first step of the workshop is regarding the driving factors that have been found in the literature review, drafted in chapter 3. The instructions that the facilitator mentioned about this first step are presented in Appendix 41. The main assignment of this first step was to think of new driving factors. The driving factors were described to the participants by bringing all the participants into a frame where those were sorted in the PESTEL format. There was also a list of explanations with examples about the driving factors present on the Miro board, participants were often viewing this frame to find some clarifications about some driving factors.

This first step of the workshop took about 20 minutes in total, of which participants got 10 minutes to think of new driving factors. In these 10 minutes it became an absolute mess, as the amount of new driving factors was overwhelming. When combined, the new driving factors are presented in Figure 44.



Elaboration Driving Factors

Domains	Driving Factors	Elaboration (examples)
Political	CBDC	Handling cash is about 1% of GDP, deal with societal ills
	Decentralization and self-governance risks	Reduce the idea of regulation, This lack of regulatory governance and responsibilities
	Regulator perception	Known misuses of this blockchain characteristic for criminal activities, currently active in the cryptocurrency environment
Economic	Cost reduction	The system works quite well but it is expensive and not that efficient for foreign transactions.
	Solve double spending	Spend the same monetary value twice
	Economic dependency	Venezuela or North Korea and Russia or China trying to decrease US Dollar dependence – create new digital currencies, also seen in EURO
	Economic impact	Labour market impact, more programmers needed and shift in employee skill set
	Risk in early adoption	Conservatism, fast changing environment, "false start", ideas are years ahead, network externalities, new problems as early adopter, competition with other technologies
	Business uncertainties	Unclear new products and services, threat to the current business models, not business priority, not broken, re-engineering of processes and integration with legacy systems
Social	Fear of missing out (hype)	R3 consortium, laboratories, however no one has the intention to use it, predictions (2030)
	Competitive environment	need for new and out-of-the-box profit models
	Corporate Social Responsibility (CSR)	Financial inclusion, serve the unbanked, BC as 2030 Sustainable Development Goals (SDG)
	Public perception	Image problem – crypto – fraud, scams
	Financial privacy	Transactional information is accessible in public ledgers – sensitive information can be found with triangulation
	Consumer protection	No one in charge and self-operating
	Culture changes	Coordination, supportive points, working together, decentralization problem "who maintains it", conservative industry, knowledge hiding
	Lack of terminology	No form of standards for terminology, security, risks, governance, management - standardization

Domains	Driving Factors	Elaboration (examples)
Technological	High Security	Cryptographic
	Tunable privacy	Consensus mechanisms
	Bottom-up technology push (Fintech)	Fintech developments pushed financial actors need new technological growth
	Quality improvement	Less hassle, faster for client, cheaper for client – automated systems
	Scalability	Transactions per second
	Interoperability	Interoperability is connecting BC to the current legacy systems AND interaction between different types of BC systems
	Cyber security	Lost or stolen private keys, the 51 per cent attack, and the access points to a system will also increase with decentralization
	Data related concerns	Data confidentiality, BC is a public system in essence
	Flaws in control mechanism	Typo's or "fat fingers" and basic computer/ programming mistakes – error correction – activating smart contract by accident
	Technology dependency	Chain reaction and compromise other networks
Legal	Leveraging IP	Become a front runner - proprietary way can become a licensor of the technology
	Enforcement	No rules yet to enforce, creates uncertainties
	Liability and accountability	No legal framework in most countries
	Jurisdictional	Most financial institutions are operating in multiple jurisdictional areas, complex situations
Environmental	Low waste potential	Possible to have low waste transactions
	Storage and computational needs (Energy)	Network of nodes constantly calculating and building the chain of blocks

Green = Opportunistic Driving Factor Red = Challenging Driving Factor

Figure 43: Elaboration driving factors

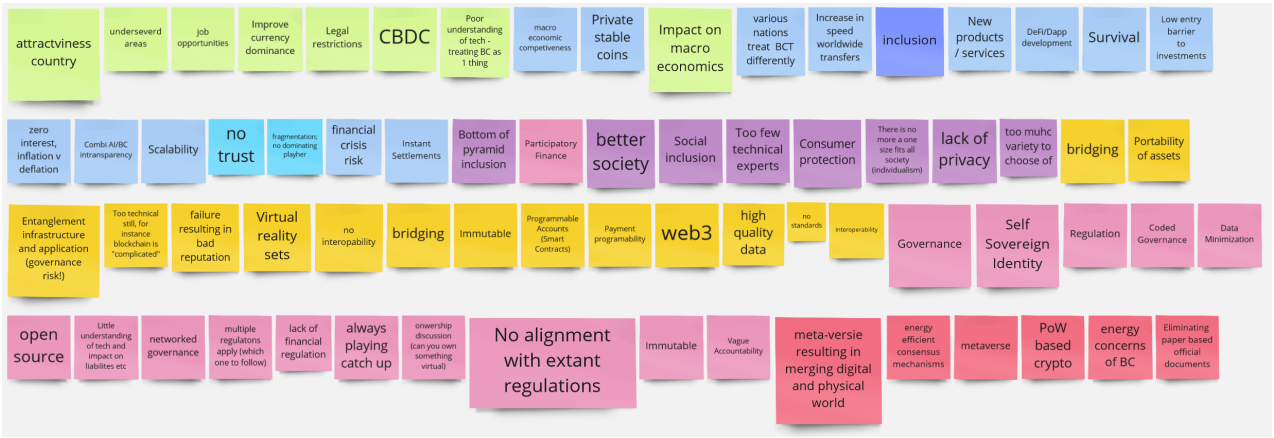


Figure 44: New Driving Factors

B.3 Ranking Driving Factors

The option "One vote per object" was always on during the workshop, see figure 46.
With the newly updated list of driving factors, ranking them is step two. The reason for the necessity of ranking is that not all driving factors are equally important. A voting tool is used within Miro to rank the factors with the highest impact and uncertainty. It is important to understand this exercise is not regarding the uncertainty about whether there will be an impact, but about what that impact may be (Cairns & Wright, 2017). This voting exercise was done in silence, anonymous, and without discussion, to keep any bias from the voting process.

Ranking the driving factors happened in two phases. First, the driving factors with the highest impact must be found. Second, the uncertainty of the most impactful driving factors needs to be determined. Given the large amount of new driving factors proposed by the expert group, various rounds of voting were necessary to find the most impactful and uncertain driving factors. Elaboration regarding how the voting tool works in Miro is shown in Figure 46. The voting round are listed below;

- **Impact voting**

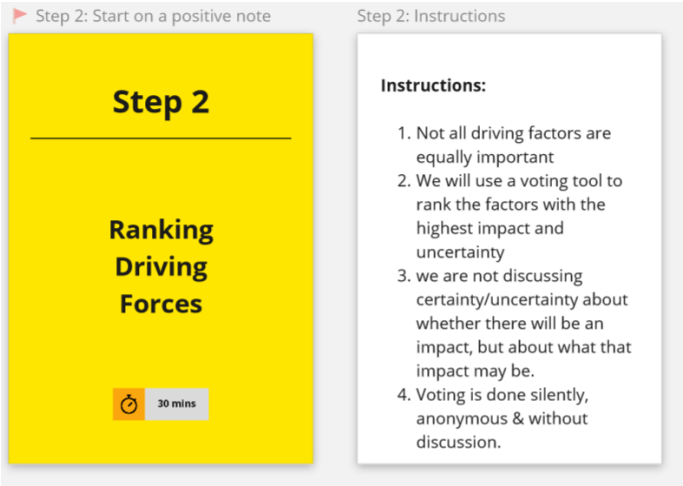


Figure 45: Step 2 introduction

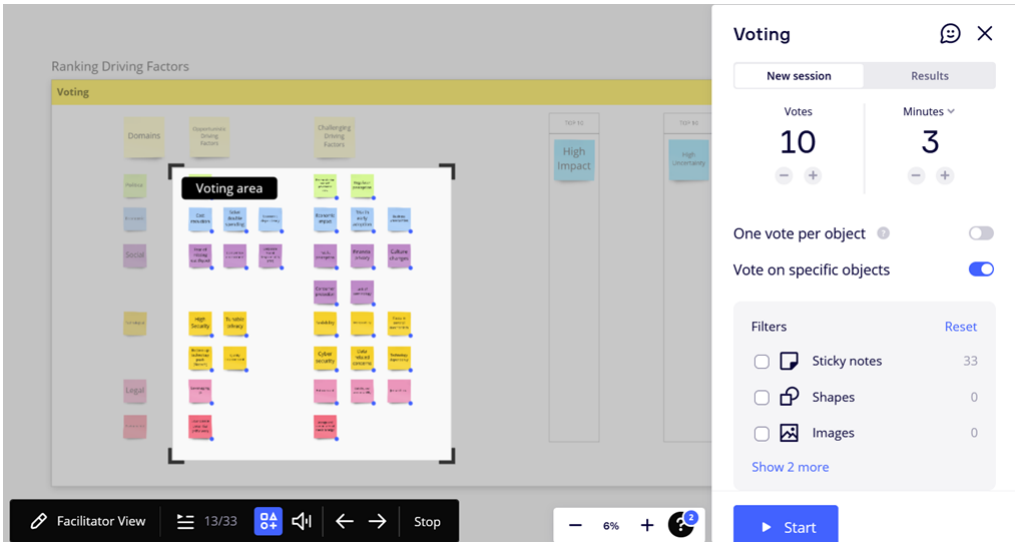


Figure 46: Step 2 Voting

Voting 1 - Top 15 = 4 min voting (15 votes per person, one vote per object)
Voting 2 - Top 10 = 2 min voting (10 votes per person, one vote per object)
Voting 3 - Top 5 = 1 min voting (5 votes per person, one vote per object)
Voting 4 - Top 3 = 1 min voting (2 votes per person, one vote per object)

- **Uncertainty Voting**

  Voting 5 - Top 5 = 2 min voting (5 votes per person, one vote per object)
  Voting 6 - Top 3 = 1 min voting (2 votes per person, one vote per object)

B.3.1 Voting results

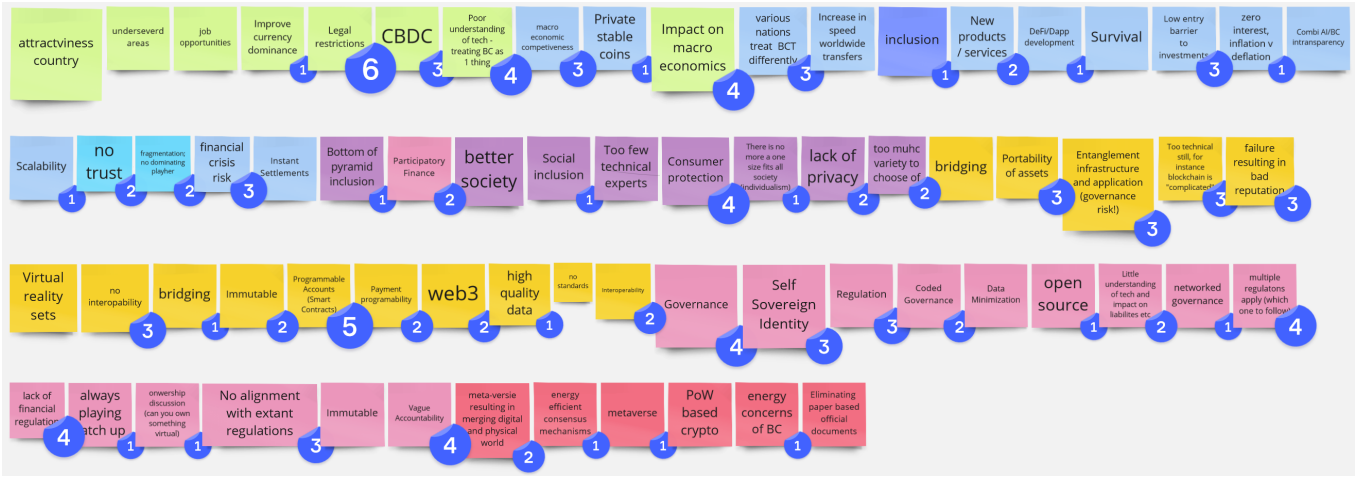


Figure 47: Voting 1 (Impact)

Figure 48: Voting 2 (Impact)

After this voting and ranking, there was a small break in which the participants could refresh themselves. During the break, the moderators cleaned up the field and prepared for the next step, mapping the most impactful and uncertain driving factors in an impact uncertainty matrix.

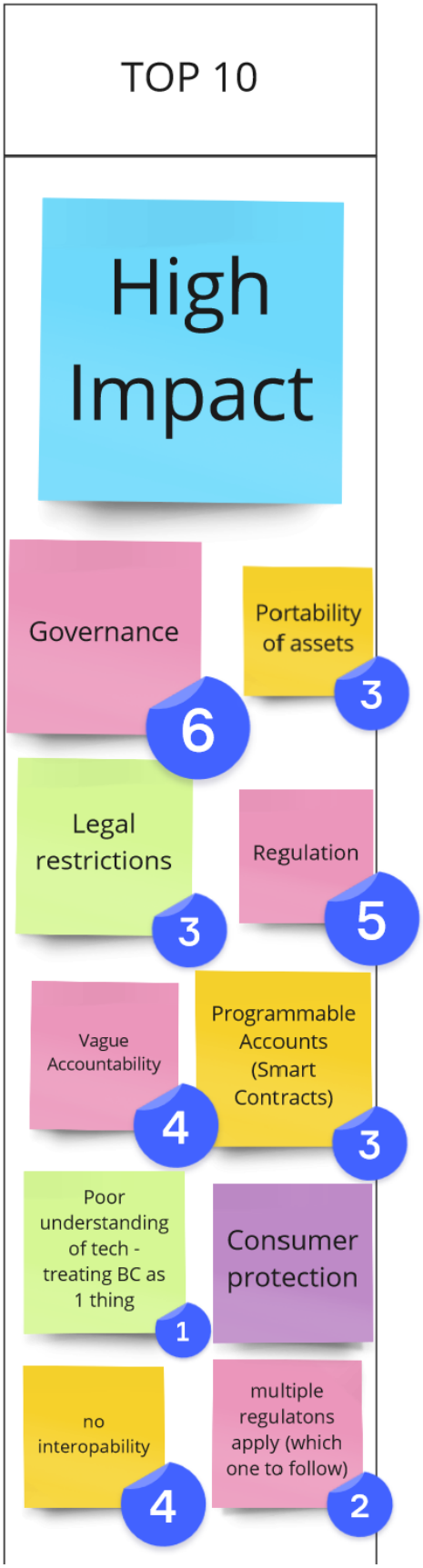


Figure 49: Voting 3 (Impact)

Figure 50: Voting 4 (Impact)

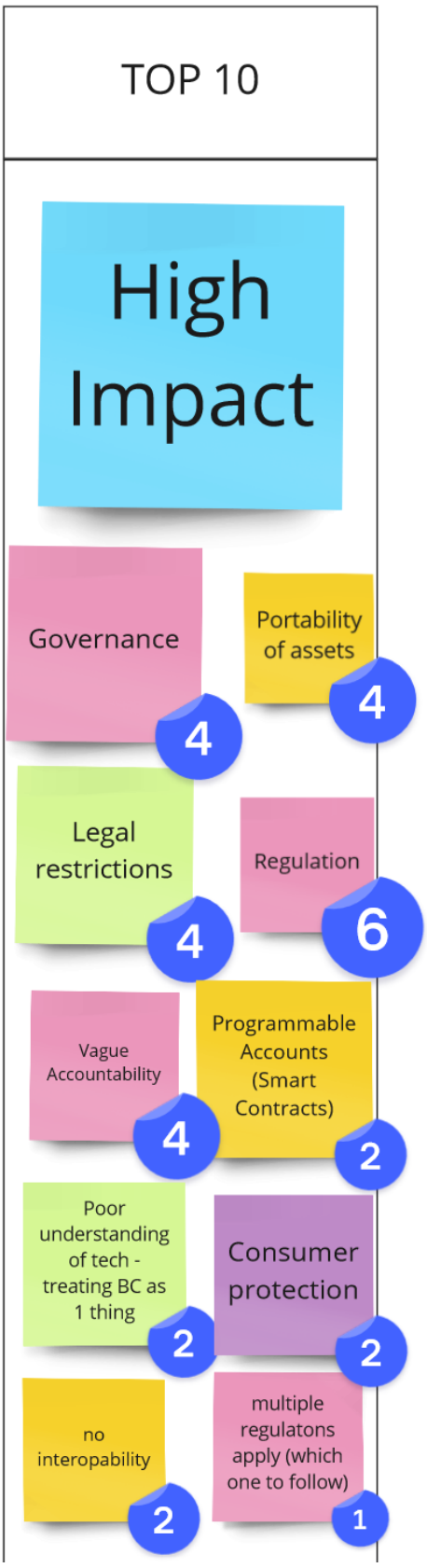


Figure 51: Voting 5 (Uncertainty)

Figure 52: Voting 6 (Uncertainty)

B.4 Scenario Framing

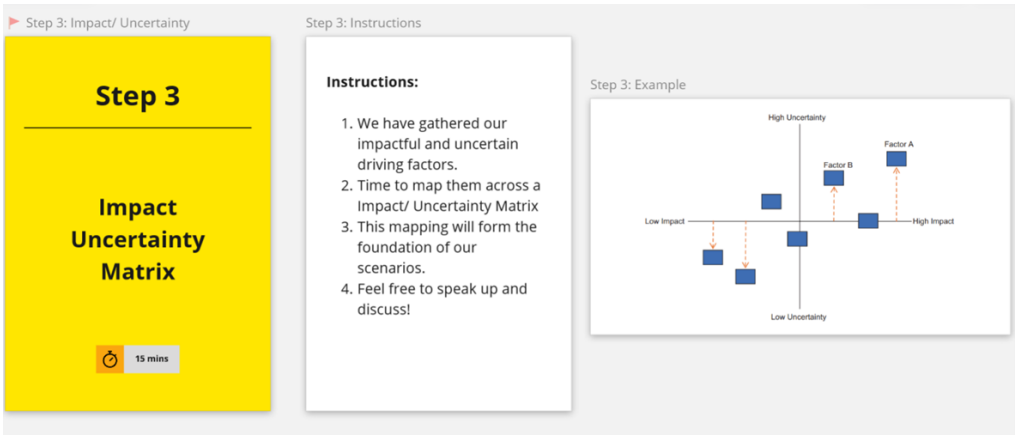


Figure 53: Step 3 Introduction

Now that the driving factors are ranked, mapping them is the next step. This puts the impactful and uncertain driving factors in perspective. Mapping these driving factors will happen in an Impact/ Uncertainty Matrix, in turn forming the foundation a scenario frame. This activity belongs in the second part of the workshop, as previously mentioned, part two is more collaborative. So, the participants could discuss and respond to questions or comment on the positioning of the driving factors in the Impact/ Uncertainty Matrix. In the case that some impactful driving factors have the same ranking based on the voting, the literature suggests that "where two factors sit equally positioned, in terms of distance from the top right corner of the matrix (highest impact and uncertainty), the one with the highest uncertainty attached should be selected, to give the greatest spread of possibilities of outturns from which to construct scenarios." (Cairns & Wright, 2017, p. 44).

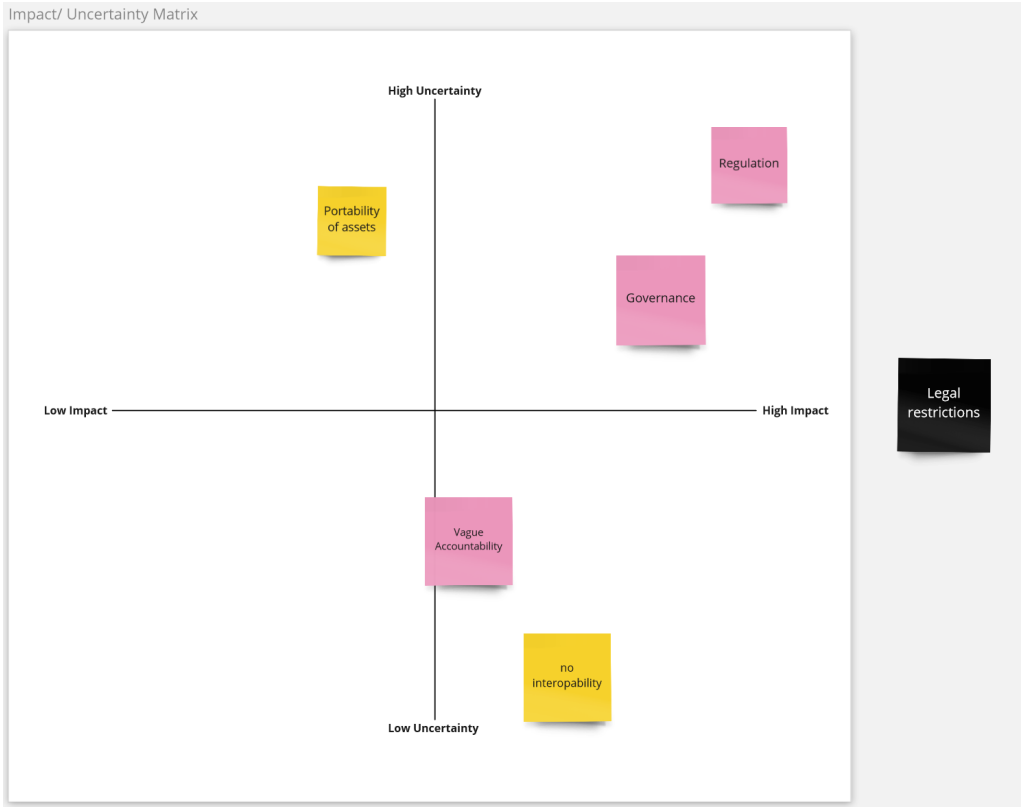


Figure 54: Impact Uncertainty Matrix Template

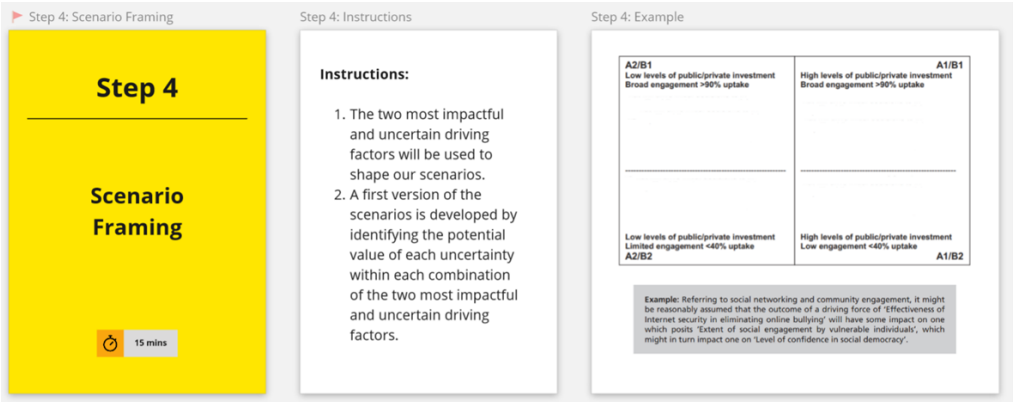


Figure 55: Step 4 Introduction

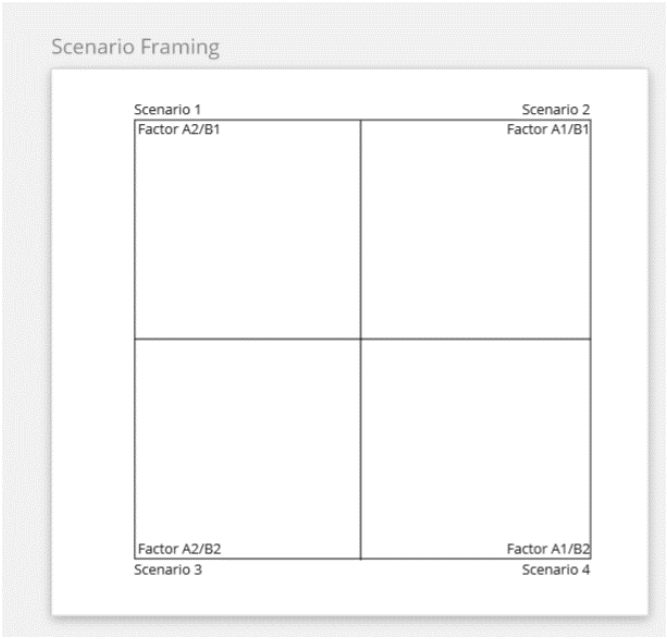


Figure 56: Step 4 Framing

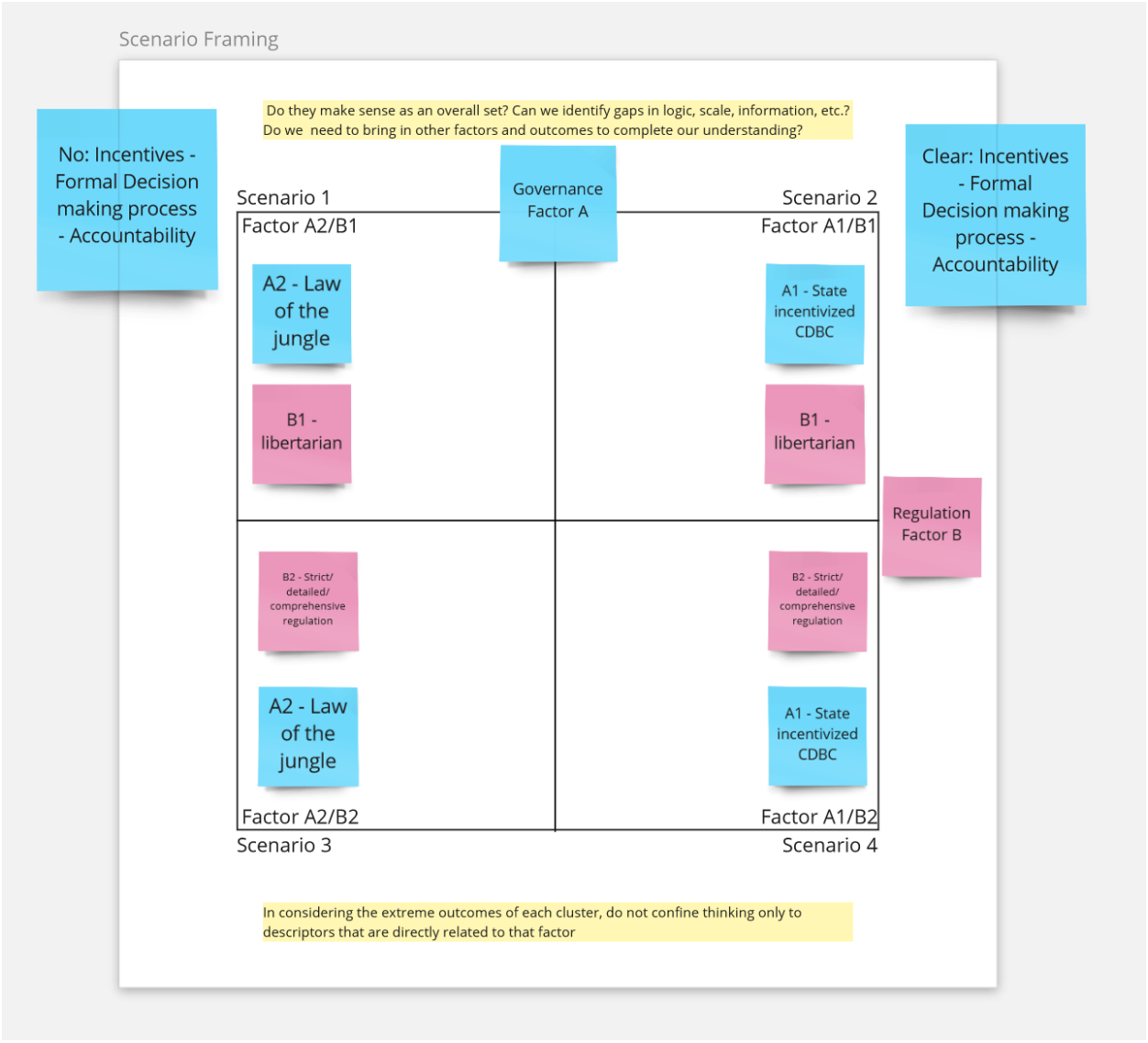


Figure 57: Scenario Frame

B.5 Scenario Development

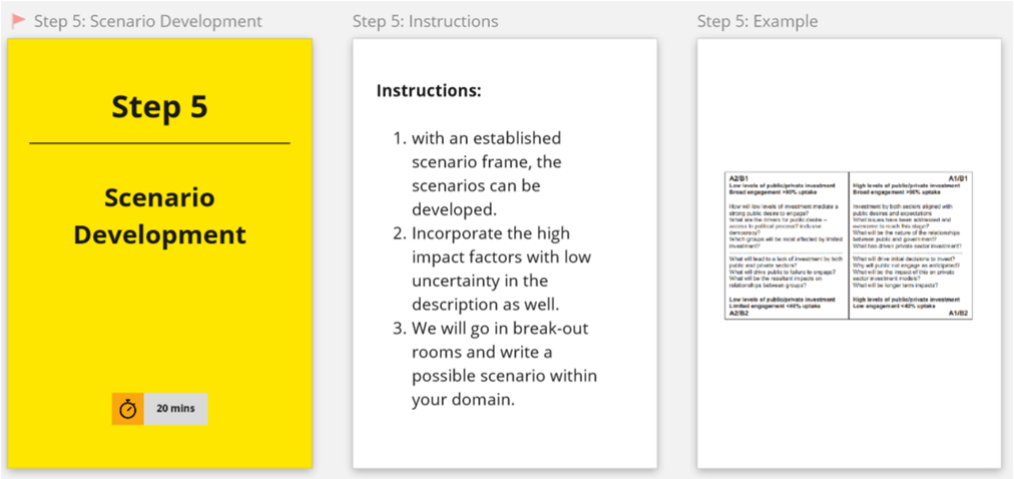


Figure 58: Step 5 Introduction

The established scenario frame from the previous step can be used to develop scenarios. the initial idea was to create break-out rooms and split the group into working areas where scenarios could be further developed. Given the short amount of time left and the smaller group than initially participated, a pragmatic approach was initiated to get the most out of the remaining time and participants. After a short rebuild of the Miro board, a work environment was created where two scenarios could be developed. The entire group went to work on scenario one (Factor A2/B1) and after a short period, they all worked on scenario 4 (Factor A1/B2).

Figure 59: Scenario 1

The Impact/ Uncertainty Matrix and a list of driving factors from the literature were provided to the participants as well. These attributes were allocated to the working area to inspire and let the participants incorporate the high-impact driving factors with low uncertainty in the scenario development as well.

It is important to incorporate these high-impact driving factors, as the name entails, they have a high impact on the future of blockchain in the payments industry. The scenario resulted in a brainstorming session with a very broad range of descriptors that characterize scenario one (Factor A2/B1) and scenario 4 (Factor A1/B2). The results of this session are presented in Figure 59 and Figure 60.

Figure 60: Scenario 4

B.6 Workshop reflection

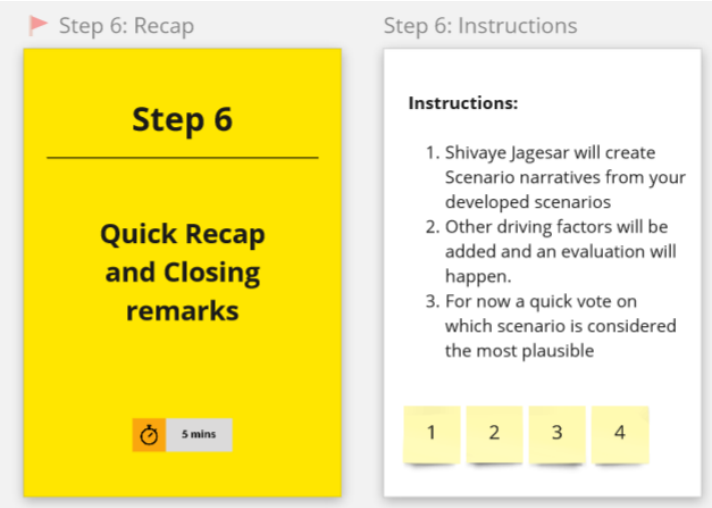


Figure 61: Step 6 Introduction

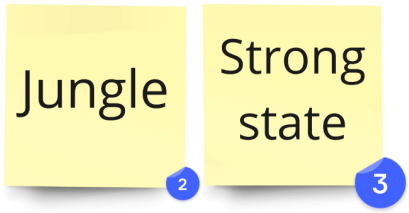


Figure 62: Voting for most plausible scenario

C Appendix C Interviews

This appendix provides an overview of how the interviews are conducted, the data is managed and the responses per question per respondent.

C.1 Data Management

For research, interviews will be held. The goal of this interview is to create a feedback loop that provides feedback regarding the evaluation of scenarios, the constructed pathways, and identified flex points. The interview questions are provided in the interview protocol, which has been shared with the participants as well. This is presented in the next paragraph.

All the interviews are held via Microsoft Teams. These interviews are recorded for transcription. No personal information is asked from the participants. Only the names and voices are stored in the recordings, cameras are not turned on during the interview. Also, the screen of the interviewer will be shared to review the scenarios, pathways, and flex points, lowering the added value for camera recording. Turning off the camera can also help make the connection more stable.

So, only the names and voices will be stored. The only reference to the respondents' experience is that three are experts in the field and three other respondents are not, but have relevant knowledge regarding blockchain developments. Explanation about the study will be communicated at the beginning of the interview for the respondents that are not familiar with the research project. Before explanation, the recording is turned on, and the respondent is informed about this action.

To secure the identity of the people who are being interviewed, the names will be generalized to abbreviations in the transcription documents. Notes will be made of information and insights gained during the interview. These notes will be stored in a folder on a password-protected computer. The computer has an encrypted system called BitLocker, even if the hard drive is swapped or stolen, access to the information is possible. Only with a unique 48-digit numerical password, the information can be accessed. Information and insights gained during the interview will also be generalized to decrease the chance of traceability to a specific person.

Furthermore, the Microsoft Teams-based interviews will be recorded. The recordings are stored within the TU Delft account of the interviewer. The expiration date has been set to one year, if there is a need to review the raw data, there is one year to do so. After one year, the recordings will be automatically deleted, however, a manual check will of course be performed.

As described, there are multiple interviews with different participants about the same subjects. This provides more validity and reliability of information and enables triangulating between data, e.g. to find outlier opinions. The Microsoft Teams-based interviews will be structured in the sense the interview questions will form the backbone of the meeting, if the respondent might drift off or the interviewer asks follow-up questions, the interview question will be taken to get back on track. However, during the interview new insight might come to light and interesting follow-up questions might be asked about certain topics which are not directly answer the interview questions.

C.2 Interview Protocol

Interview Protocol Roadmapping

Introduction

Thank you for taking part in my research. The purpose of this interview is to evaluate the scenarios developed during a previous workshop, pathways towards those scenarios, and flex points. In my current research I have created these pathways and identified the flex points. The goal is to verify these results by collecting information from experts. If you have not participated in the scenario development workshop, I will briefly explain the scenario development process.

Before the interview, the scenarios, pathways and flex points will be shared with you. This creates to opportunity to familiarize yourself with the research and allows to keep the interview relative short. If you have the time, try to reflect on the scenarios' implications for the future of the blockchain in the payments industry. Does this reflection correlate with the presented pathways?

Recording instruction:

The recording will only be turned on with your consent. No personal data will be used in the research project, the recording will be transcribed and summarized in order to process in my master thesis. Your confidentiality and anonymity is important to my research project and will be protected.

Interview outline:

(If someone has not participated in the scenario workshop, elaboration will be first provided regarding how the scenarios are developed (~ 15 min))

1. Evaluation of scenarios questions (~ 7.5 min)
    a. Do you think that the scenarios (Appendix Scenarios) reflect the development frames?
    b. What scenario would you consider the most plausible? And why?
2. The pathways questions (~ 15 min)
    a. I will introduce the shared pathways (Appendix Pathways). Do you agree with this paths towards the scenarios? What should be changed or is something missing?
    b. Are the allocated time intervals in the pathways realistic from your perspective?
3. The flex points questions (~ 7.5 min)
    a. I will introduce the flex points (Appendix Flex Points). Do you agree with this flex points? What should be changed or is something missing?
    b. Are the allocated time periods of the flex points realistic from your perspective?
4. Do you have other remarks that you would like to share or address?

Wrapping up:

Again, Many thanks for participating. You will have the chance to stop the recording or no longer wish to participate in this study at all times during the research project. The final results will be made available to you and made public between June and July.

Kind regards,
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Figure 63: Interview Protocol

C.3 Interview Responses

This paragraph will provide summarized answers from the respondents per question. Starting with the questions regarding the scenario evaluation, then regarding the pathways, and finally regarding the flex points.

C.3.1 Phase One - Scenario Evaluation

People	1a. Do you think that the scenarios reflect the development frames? (Scenario Techno-verse)
R1	Yes, BigTech is huge and competing, global players, struggling with legal part, people are not aware of BigTech involvement, BigTech dictators. I think they reflect law of the jungle and libertarian.
R2	Quite a bleak scenario. I think it's correct. That's the big tech organization has substantial power. **Economical** – geopolitical will be an issue **Legal** - I don't think that there will be constantly fishing behind the net. I do agree with the **Social** - It does help if a lot of **awareness and learning** is mentioned. BigTech has now freedom of speech as counterbalance act for their social platforms, no sure what that will be for the payments area.
R3	I think it's an accurate description of both. Law of the jungle and libertarian, like Big power for the tech companies and a struggling government, basically. test
R4	says given that blockchain is everywhere. I'm not sure you can say that. could also be, not blockchain that that is everywhere, but some other technology. **Political** - politicians are lost, I think that's already the case. **Economical** - could also be that **digital banks become dominant**, they already exist in some form and not blockchain based possibly. Regarding euros and in U.S. dollar dependency - innovations in the ease of cryptocurrency to normal currency might become also. And well more innovative or more like easy. **(so the good things of crypto to normal (digital) currencies)** **Legal** - very accurate **Social** - interesting remarks, can definitely happen. Maybe add even cause like a wealth divide, potentially **Technical** - Interesting. The threats that are not even imaginable right now. – mention quantum computing. Also bigger impact if the system is compromised when it's all blockchain based. also even mention the **large energy consumption**, how to deal with sustainable energy – **safeguards for energy** **Overall**, I would say it's very much in line with your development framework.
R5	Yes, it reflects the frame **Political** - incumbents or newcomers can also become a BigTech. **Not sure of government is lost**. E.g. after a while, they are not completely lost. Countries will thrive that are tech – agreed. really feels the law of the jungle **Economical** - makes sense, The circulating movements are decreasing that I would agree with. new economic systems, new circulating currencies – makes sense, So then **there will be entire economical markets within just software within someone's glasses**. **Legal** - MICA, DORA, still accountability will be vague. Enforcement as well, e.g. metaverse. Copyright is so hard. **You cannot hold a light piece of code accountable.** EU partlement, all of this crypto and meta, start investigating this, but indeed reactive. **Social** - first part makes sense, but second part, I'm not quite sure because people that have unstable internet connection, can still do business now, and digital literacy, people will go to more hoops but not left out, they will struggle, yes. **Technical** - yes, agreed, e.g. there's still a factor of human error.
R6	I think it's really nice. I do think that if you say with libertarian, I get what you mean with your descriptions. People who are very tech – they are thriving, who are not tech will be left out. So, actually the assumption in this is that if you have little government and little regulations, then the people with the most tech background are doing better. – interesting bridge. Perhaps add "why" in the text. I do feel that this scenario is not realistic, But interesting situation, **people will always try to govern/ regulate it** - law of the jungle will be hard to remain.

Table 24: Responses for question 1a **(Techno-verse)**

People	1a. Do you think that the scenarios reflect the development frames? (Scenario Big Brother)
R1	A link to this scenario - there was **stable coin crash recently**, making them not so stable anymore. It can even be considered as a financial crises to some, people get afraid of that. If you go for this scenario, it is quite hard to regulate because the whole idea is that you can't regulate it, it's decentralized.
R2	**Political** - first sentence should be public organizations instead of just public. I think it's a **mistake to think that public value can only be created by public organizations**, also commercial. The national payment system can be the back bone. But it will never be the ones that actually do the payment services, at least in Europe. **Economical - legal** - There needs to be a balance between economical and legal. How far do you regulate? Because the public organization have to manage the systems no, that kills innovation. Also, the knowledge is in the market party with the market parties and they also have to invent incentives to innovate because of competition. **Technical** - Who has the **technical knowledge?** Those will rule the world in a sense
R3	**Economical** - Under the heading economical you say politicians are not able to govern the system. That may well be true. But in such cases, I think **politicians typically hire experts** who can design effective strategies to deal with issues. I'm not sure that I agree with your description there. Also not sure that the development frame, entails a big brother society. – comment on the name. This does not make a surveillance society, we have laws, Eurocentric approach, privacy, the sentiment that it would not be this strong. **Follow-up question:** Monitoring of flows– AML and KYC is now happening, big brother for financial data also not possible? The name is not representative. Financial regulation, it is not necessary that they know specifics. You have a point her because you only talk about financial data.
R4	a national blockchain based payment system which is diffuse country, right and controlled by a government. **Types of governments in different countries are super different.** Offer it as a complexity in your text. **Political - Difficult**, this is also very dependent on the country. but indeed if you look into your framework like extreme regulation, extreme governance. Then you're going to, well, almost dictatorship. But normally, I could not imagine this happening within 10 years. **Economical** - I think financial crisis are to the horizon because the government does not have their own way of making money anymore. If it's a similar blockchain to Bitcoin. **Legal** - a little bit questionable if the old fashioned Fiat currencies are being down skilled or made illegal by governments. think it's just **very complex** this one because. You have different things to take into account, like the scope, like what in **what world** **Social** - take into account older people that are not tech savvy. They might totally lose their trust in the government as well. you go a bit **too far when you say that all people are happy and everybody trusts** **Technical** - Sounds like you're also hampering maybe innovation, Makes sense
R5	**Political** - Programmable, they can force you to spend on certain things. **Economical** - when the **money supply is code**, this becomes much more easier/ different, so many more ways in manipulating the market than quantitative tightening now. Their policies now takes months to happen, with the new blockchain system, it is instant, s**o I'm not sure about financial instability**. **Legal** - in the worst case – it does make sense – but **take political systems in account**. bigTech might shift due to the political systems as well. banning it is a **prisoners dilemma**. Every country has to do it, otherwise, companies will just go to other countries, with the effect of loosening regulation and then they will come back or stay. **Social** - not sure if people will be happy, if something happens, than maybe. People will not go to extreme lengths, settle to be content, but not necessarily happy or safe. **Technical** - technical can work if everyone does it. The incremental part will only be true if the prisoners dilemma is met it completely fits with states, incentivize CBC and strict direct comprehensive regulation
R6	Power on the national level for the government. how realistic is this, vibes feel like strict counties. Agreed with the development frame. It's more realistic than the previous scenario. But maybe that's because some countries currently already have this kind of a Big Brother concepts.

Table 25: Responses for question 1a **(Big Brother)**

People	1b. What scenario would you consider the most plausible? And why?
R1	Scenario 2 is most feasible I think. We get these event now, and politicians always react on events, then the take action. You got to extremes, when something happens, then you start with action. They do too much. You go from one extreme to the other. But I think the **tendency we will be to be more strict.**
R2	I'm afraid I have to answer that it really depends on the country, on the political system of a country. **Follow-up question:** how do you then see the Global interactions between these digital currency ecosystems, will they be in interoperable or not? I think quite the same as now. You know, I'm not having access to financial markets and does not to trade or export import Relationships. So in that sense you could contrast now maybe a country like Brazil, if that payment, you know all the all the start-ups in cryptos and so on versus strong state blockchain initiatives.
R3	The US is more techno verse and Europe is maybe more Big Brother. But then we do not take into account that the world is more than Europe and the US. **Follow-up question:** to which side of the scale will at first develop and then eventually it will? Probably end up somewhere in in the middle, but now it needs. It needs to bend a certain way. It's now a bit more bent towards the techno verse. Europe is. You know, starting to push back, started with the enactment of the GDPR back in 2018.
R4	Techno-verse. Definitely. Overwhelmingly so I'd say. but not necessarily, with a certainty that blockchain will be in it, but definitely the like the environment that you have sketched. Because I think there's already a lot of places where you see that's happening.
R5	There is already an aim towards to big brother, but it seems that bigtech has large power, so slowly shift to techno-verse and end in the **middle**. where sure we have CBDC, but we also have to some extent freedom of these cryptocurrency companies.
R6	depended on the current political situation. Western countries – more to techno-verse, more room to become law of the jungle. While other countries are already big brother. **Overall**, big brother is already there, while techno-verse not yet, in that sense it might first bend that way. I'm not sure if there is any place in the world where there is such little regulation as the techno-verse.

Table 26: Responses for question 1b

C.3.2 Phase Two - Pathways

People	2a. Do you agree with this paths towards the scenarios? What should be changed or is something missing? (scenario Techno-verse)
R1	**Interoperability** might play a role, is a problem connecting the virtual spaces. You see now the discussions with the metaverse or that there's also interoperability problem P2p-products, a lot of products are regulated, so innovative products that are not regulated. (perhaps add that as a change) Why google has a banking licence in Estonia and they can use it in EU. There is threat, I think you should **show that they try to circumvent regulation**. Also, show that BigTech needs to get **critical mass**, sufficient users. You might also want to add some geographical impact and diversity, As one BigTech might be dominant in one areas and one in another area. Also, the current we have a **shortage of expertise personnel.** if there's a kind of financial crisis. So the big tech should manage that. Some sort of mechanism. they have so much money, they have more, probably more money than nations. and that **they get more trusted at one state**, so the currency you Facebook will be more trusted than the than the euro.
R2	**External** - is fine **Internal business strategy** - So they will still be holding up on to their, You know, market power, you could say market privileges. **Technology** - Perhaps move the new services to the product/ service/ system row instead of technical (same year) **Resources** - technical personnel, the demand for knowledge
R3	we tend to overestimate the impact of technology in the short-term and underestimate in the long-term. Blockchain has huge challenges regarding governance, it is not clear and not established, blockchain might collapse, due to this governance - e.g. bitcoin and Dow hack. I think a **governance is a big challenge for blockchains**.
R4	Maybe the techno-verse Might have a timeline that could be shorter than the Big Brother. They will come across a lot of lobbying against what they are doing. And I think appreciating the power of lobbying companies. Uh, they are very powerful Maybe the time line for Techno-verse a bit quicker even than eight years, because you've also seen how fast Bitcoin. and now also a lot of other financial services are evolving at this moment.
R5	**External** -seem ok, logical lay-out, makes sense that big-tech rules at the end. **Internal business strategy** - as far as I'm concerned, the these **banks in NL all fall under DNB**, and they followed their regulations, so, cutting loose from fiat seems not likely to me. **Product/ service/ system** - year 8, switching costs are high, it is hard to judge. They might open it and interoperable, try to keep entry of barrier low. But yeh with centralized currencies, they will keep switching costs high **Technology** - ok **Resources** - I 100% agree with
R6	private blockchain have a lot of governance. What type of governance? Regulatory governance you mean probably? **Note:** confusion with public/ private BC architectures – rewrite it to avoid confusion

Table 27: Responses for question 2a **(Techno-verse)**

People	2b. Are the allocated time intervals in the pathways realistic from your perspective? (scenario Techno-verse)
R1	Hard question, I say put everything in year 3. if you have year 6 and 10. That might be more because the problem with year 8 is it's far away.
R2	Cutting loose from fiat will not be so short-term, year 8 or 10. **Internal business strategy** - Vision of internal business strategy depends on country as well. **Technology** - p2p financial products and services are being introduced in year three is actually already going on – either move to year one or make it large-scale.
R3	I don't have any strong feelings about that. I don't know.
R4	In year 3. Cutting loose from fiat. Might be a bit further in the future than in year 3. I think it's plausible, but I think it will take longer because, it needs a lot of network effects. before you have well reach some plateau that you need.
R5	**External** - year 8 maybe a bit fast. For legal framework. **Internal business strategy** - year 3 is too early, cutting loose from fiat. Not easy.
R6	**External** - Time frame is nice. **Internal business strategy** - it is not going that fast - past 8 years we have developments until the current stage and not much adoption, a lot of initiatives. However, When it starts, it will go fast.

Table 28: Responses for question 2b **(Techno-verse)**

People	2a. Do you agree with this paths towards the scenarios? What should be changed or is something missing? (scenario Big Brother)
R1	Attention between the financial institutions and BigTech, probably **in favour of the traditional industries instead of BigTech**. The role of small companies (here they are bought by the financials). Banks are competing, core business is compliance, others in ICT, and some in banking in business. They are good in compliance, if they don't, they get large fines, they have incentives to be good. **Follow-up question:** you think that I should incorporate a big tech in this as well? Yes, I wouldn't be surprised that a BigTech might be split up into a BigTech part and the banking part. but it might be that the regulation will force them to split them, like we have seen with consultants and accountants.
R2	**External** - market uncertainties is fine. I do think like the more negative oriented blockchain related defence. **Internal business strategy** - Do you actually think that current customers could already easily switched to CBDC, maybe if it is regulated **Product/ service/ system** - enforcement of legal framework, but it demands a lot of knowledge of that is actually not naturally in the hands of public organizations. **Technology** - In year one, the public agencies are starting with pilots. That's not a technological thing, is it? - rather into a product service and system. whether people prefer having that over the private ones (pilots) in year 1. **Resources** - formulate knowledge hiding different.
R3	I don't see it happing, a ban of private blockchain initiatives. the vision the government is ruling, yes, very good. Yeah, public values in mind. Traditional banks are still the gatekeepers of financial markets, I agree with this
R4	**Technology** - think the technology one is very plausible A feasibility perspective and Big Brother. Government becoming a shareholder of financial institutions. They usually don't do that. But this could be the case that they do, but normally they don't, they leave to the market and governance a bit separated. - depends on the country
R5	**External** - year 8, financial stability not at risk probably. a lot of smart people that that are working with the central banks. But their feet are tied with an anker because the old system, but with new systems, they are open and have all the options they can think of, complete freedom. **Internal business strategy** - agree with it **Product/ service/ system** - maybe international system – others is fine if the CBDC project goes through, with restrictions, people will slowly move to illegal market. Surpassing the restrictions with "fake" transactions. Just for products and services, maybe add the second economy "illegal economy" - People are gonna find ways to take the money that they have legally to a **second economy**.
R6	**External** - year 8 financial stability - currently, in financials and crypto, everything is volatile due to the lack of regulation. No one can compensate it. While government based- can become more stable. The central authority is a good thing then, there are mechanisms that will help you. I was actually thinking that's financial stability is that there's more financial stability than the other scenario. **Internal business strategy** - – I like it , we see that banks try to do it, on their own, but the governance, the government is too strong. In the end they will just become a shareholder and follow the government.

Table 29: Responses for question 2a **(Big Brother)**

People	2b. Are the allocated time intervals in the pathways realistic from your perspective? (scenario Big Brother)
R1	I think probably the regulation in China. I would expect will go faster than the regulation in the US. Perhaps US is more scenario 1 and China more scenario 2. Europe will be relative fast a normal course. **I think year 3 the first signs and year 5 the whole world moves.** So this is more about (global) politics maybe in this scenario and strategies then the more about the market. I don't know if they get too complex to add this. In this scenario that you might separate financial issues from the other issues using regulations and that might be in year three or something like that. I put everything in year 3.
R2	Do you actually think and you're afraid that? Current customers could already easily switched to digital in year 3. **Response:** regarding CDBD for citizens - year 8 was too late, that's why year 3, should I make a column with year 5 or 6? I would not create another year Column.
R3	If it is year three or year eight, I don't know. it could also be year 5 and year 10 year one is good, year 3 – vision is good – year 3-8-10 is fluid, it is sooner further away than earlier. With development, it is not like things are changing fast. Technology may be moving fast, but people and the knowledge is not moving fast and slowed down by lack of human understanding. – all later. **Response:**working papers about issue CBDC (ECB), but there's not much happening Concrete Mark my words until some other jurisdictions introduce CBDC. But that may be a **real incentive** head that **they don't want to be left behind**, I think typically developments are a lot slower than. We tend to think that they are.
R4	maybe not completely obsolete in year 3 already. financial stability at risk could occur already earlier I would say it's quite plausible. The scenario you were sketching here the time.
R5	no strong feelings regarding this time line
R6	no strong feelings regarding this time line

Table 30: Responses for question 2b **(Big Brother)**

C.3.3 Phase Three - Flex Points

People	3a. Do you agree with this flex points? What should be changed or is something missing?
R1	Think about another name for regulation at the top, maybe call it **market regulation.** Interoperability and consumer protection (accountability) are also regulation, it's confusing now. **Question:** How about funding? It's the least important. What might be important is, **who's leading or who's taking the (first) initiatives**.
R2	Do you make a good distinction between regulation and the law? - confusion for regulation **New point:** but I miss. Here is the **development of** the of the blockchain of the crypto itself, **the market itself**. It can completely break down or it can actually become common way of doing transactions. **New point:** I would say the next flex point is safety - more hacking and uncertainties - could be the price of quantum computing **(cyber security)**
R3	**Interoperability** – I would expect that blockchain have an incentive to be interoperable. If it is in their own interest, will make the incentive to make it happen. **Accountability** – for blockchain, there is no such thing, maybe the law demands that there is some consumer protection. It can only happen if you use, custodian wallet providers. - which basically means that you go back to the centralized system.
R4	Makes sense accountability, should pretty clear. Good that this is included Regulation - If it's completely regulated, isn't always anonymous. complete freedom - I would say then you have everything being anonymous because on every user is completely free to do what they want. So maybe just **rewrite** it a bit so that other people don't. Read that anonymous is linked to completely regulated. Funding also clear.
R5	**Funding** – a lot of private money now **Interoperability** - guess when its ripe, but depends on survival of the fittest **(market development)** –zoom/ teams example. When the pandemic started, everyone made their own videocall system, but eventually Teams and Zoom became mainstream **Accountability** - regulation are so many details and difficult. I was literally last week looking into this part of accountability. **People are still very confused. Everybody is just asking questions. Nobody's providing any answers.**
R6	**Governance** – can be a high impact factor and uncertain, should be a flex point as well. But I'm not sure if you should take those two (governance and regulation) as your flex points because there are also your dimensions (development frame) **Question:** Rewrite to market regulation? – yes. **Funding** – maybe, not that important **Interoperability** – good **Accountability** – good **New point:** Transaction time/ effectiveness – efficiency – may have big impact. **Question:** Can it shift the developments in the future? **Response:** Yes, shift to the techno-verse more, to regulate ecosystems it takes a lot of time, and techno-verse is fast. So if this factor has a high efficiency - this will actually have a shift to the techno-verse.

Table 31: Responses for question 3a

People	3b. Are the allocated time periods of the flex points realistic from your perspective?
R1	**Regulation** is already started playing and getting stricter. **Interoperability** is too far away right now to put immediately. Yeah, maybe three years is a better, 3 till 10. Also for **consumer protection** because I think 5 year looks fairly far away from me.
R2	I agree with your Assessment of your time period The **cybersecurity** (quantum computing) another time period will be not 10 years. (starting). And the **development of the market itself** - that's 0 - 5 years.
R3	I don't know, maybe longer time periods
R4	**Regulation** - 10 years makes sense to me because Also it Bitcoin, you can see that it's already been in place. For quite a long time, and they could still now take measures to regulate it. I would say 10, closable. **Could even be until 15 years** because the government has a lot of power - But which **also differs across countries.** **Funding** - I'm not sure how much impact funding would have on which uh pathway you go on, If we would have a very, very large impact **Interoperability** - Yeah, 5 to 10 years. logical that you say that it's only will have an impact after five years. **Accountability** - that's the last one. 5 to 10 years? I think accountability might actually be one that's spanning for longer than 10 years – not sure for how long, but I could imagine that it could be longer than 10 year. **Note:** Maybe you can make some nuance in these flex points in their importance
R5	**Regulation** – not start with zero for time frame – 1 or 2 to 10. don't think it will be completely regulated in 10 years because you know, it's constantly evolving. – also longer than 10 years maybe. **Funding** – So yeah, zero to five years makes complete sense. **Interoperability** - time makes sense - more than 10 year in this case **Accountability** – maybe longer, maybe than 5 and more than 10. Maybe even 15 years.
R6	All good, only **accountability** – maybe 0 – 10 for accountability (of transactions)? You can always trackback. However, 5 to 10 years will be good because in the beginning of blockchain ecosystems, it's not really clear

Table 32: Responses for question 3b

People	4. Do you have other remarks that you would like to share or address?
R1	no, congratulations with the work. I'm very curious about what other interviews are saying.
R2	Countries are actually able to **close down Infrastructures**, closing down the Internet. So, we haven't really looked into this **Political systems**. That could also be a Turning point – if countries turn their back towards a scenario. Currencies in the libertarian scenario, could actually take out the influence of geopolitics. If the digital one is just flowing through platforms and privates, it will be far harder to shut it down.
R3	Again we see technological development invites us to really think about how we want to organize things, the aims. I like to reassess, re-think how we want to organize society. If there is not a necessity to do that, as blockchain does, we just go on as we always did. Never waste a good crisis – technological development – things are suddenly undermined. That really **fundamentally to rethink, what do we want to achieve.** You ask the right questions.
R4	it's a nice research and I wish you good luck with completing it
R5	interesting research. A lot of work and a **lot of difficulties** but **very loose**, some are difficult
R6	no

Table 33: Responses for question 4